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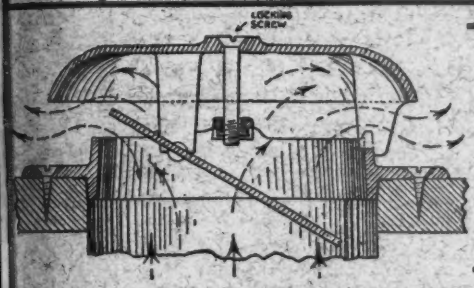

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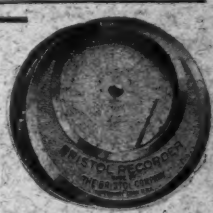

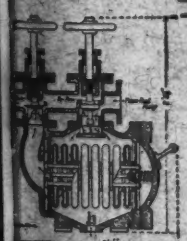

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THE HEATING AND VENTILATING MAGAZINE

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The Natural Ventilating Standard

By KONRAD MEIER.

Although the engineering profession will naturally listen to hygienists in seeking a standard for its work and has been trying of late to reconcile their recent, apparently conflicting discoveries and opinions, there is, on second thought, much ground for the criticism expressed by a prominent hygienist that much has been quoted by engineers on physiology, but very little said on engineering problems.

We need only to remember that there is always a natural standard to which no physiologist can take exception. The engineer should be able to define this standard and to solve the problems of meeting it, but evidently, much remains to be done in this direction.

The object of heating and ventilating reduces itself to the reproduction indoors of the natural outdoor atmosphere at its best, or to approximate it as far as conditions will permit. This ideal is definite and simple enough, but it is not adequately expressed by temperature, humidity and carbonic acid percentage of the air. These customary standards are therefore often misleading and do not by any means assure comfort and wholesome air. For instance, a room may have the stipulated air temperature of 70° F. at normal humidity and still be chilly while the walls remain cold and damp. Again, the same room may feel close at other times, at the same air temperature, when the surrounding objects radiate too much heat. If the customary requirement of 70° F. is interpreted to be an average air temperature, there is much chance for variation between floor and ceiling, also from inside toward outside walls. Temperature readings, especially dry bulb, are notoriously deceptive and used often mainly for moral effect. Occasionally a customer can be satisfied by merely shifting the thermometer. The heat, therefore, must not only be imparted to the air, but in a good measure to the structure itself, and be fairly distributed.

A fixed amount of moisture at normal air temperature may give different degrees of comfort according to emission or absorption by the structure, that will effect the relative humidity and sensible temperature. Even the same percentage of saturation will give the impression of more or less dryness, depending on the amount of dust in the air. It should be remembered also that the bearing on comfort and health of relative humidity in itself, within reasonable limits, has never been demonstrated conclusively, it being almost impossible to exclude all other factors that will interfere with a fair comparison. A standard percentage of humidity is therefore of questionable value and comparatively unimportant in any event, since, after all, we may feel comfortable outdoors within a con-

siderable range of saturation. Objectionable extremes can be avoided in ordinary situations by proper selection and use of the heat carrier and of the ventilating system.

FUNCTION OF CARBONIC ACID TESTS.

As to the customary tests for carbonic acid, they will merely give an indication to what extent the products of combustion generated by the occupants or other sources are being diluted. Under stated conditions, this may be accepted as showing the quantity of ventilation, but not the quality, which is most essential. Such tests can never prove the purity and wholesomeness of the air, since it is often made unfit in various ways, not indicated by the percentage of carbonic acid. In fact, the kind of vitiation measured by it is now considered to play a minor part. Lack of sanitation, sometimes in connection with heating, or even in the ventilating apparatus itself may be a factor in polluting the air. For example, a system that will raise or stir dust, vapor and heat instead of deftly picking up and removing them, is often worse than no artificial provision, even though it might make a better showing by the carbonic acid test. Other methods of testing, likewise, have a limited application. There is no better device than the human nose to tell an undesirable state of the air. It will also help to trace its sources, which may require attention.

HEATING SYSTEM SHOULD BE ADAPTED TO STRUCTURE.

It is evident, therefore, that other points must be considered besides temperature, humidity and the rate of dilution or renewal. The natural standard indeed gives considerable latitude in respect to these items, which is really consistent with the natural conditions and changing requirements, but it will define more clearly some other essentials. The most vitalizing and agreeable atmosphere is that of a sunny day with cool bracing winds, giving energy direct from the heat rays of the sun, stimulating respiration and the thermal functions of the body. To approach this, a certain amount of radiant heat seems necessary to produce comfort, while the air temperature should be kept down, thus creating a condition similar to the sense of relief that one experiences after flushing a well-heated room by windows, the air itself being cool and sweet, while the walls regulate and keep up the sensible heat. Hot air, for instance, even when fresh when applied in rooms with thin, cold walls, will not have the same effect. Direct radiation with independent air supply to supplement leakage as far as needed, would seem to come nearer to it in such cases, while massive buildings, requiring little heat, can be warmed successfully by air, which need not be as hot and is more likely to be wanted for ventilation. Again, occasional airing would not interfere as much with the heating. In other words, the system of heating and ventilating should be adapted to the structure, so that a room may be kept comfortable at the lowest air temperature practicable.

THERMAL RESERVE OF APPARATUS AND BUILDING A FACTOR.

For similar reasons it is desirable to consider the thermal reserve of the apparatus and building. Solid walls are slow to heat to a point where a room will feel comfortable. Hence, if air is the heat carrier, the service should be continuous or ample time should be allowed for heating up. Failure to do so will result in cold walls and high air temperatures in the effort to relieve the chill, creating undesirable, uneven conditions. Light and permeable structures should have some reserve heat stored in the apparatus itself to create more equable temperatures. Hot water heating will often meet this requirement by preventing excessive drop of room temperatures over night that would call for extra heating capacity in the morning and higher temperature of heating surface.

The heating should also be suited to the method and need of ventilating. In cases where windows are used to any extent in addition to or without some artificial system, direct heating is always best, as it will not be interrupted by outside influences, but is stimulated, if anything, according to need. Indirect heating, even with blowers, cannot be depended upon while windows are open and is liable to be upset for a good part

of the time, because of disturbances throughout the structure. Except in massive buildings, where occasional airing cannot cool the rooms appreciably and where the ventilating requirements more nearly coincide with those for heating, the heating should be independent of the air supply. As a general rule, the need for ventilation is greatest when rooms are liable to become overheated, while in cold weather the increased natural leakage and circulation justifies a reduction of the artificial capacity.

Again, the air supply is often wanted only for brief periods while the heat must be kept up longer for various reasons. It would seem, that each problem could be solved to better advantage and higher efficiency secured, if treated by itself in the most straightforward and direct manner. Partial combinations with the double ducts and other ways of varying temperatures introduce mechanical and other difficulties and rarely accomplish the results expected.

PREVALENCE OF DUST IMPORTANT FEATURE.

Heating and ventilating equipment that would meet these requirements as to agreeable air and wall temperature, proper distribution and efficient operation, may still lead to complaints from dryness owing to a prevalence of dust, from foulness owing to dust combined with moisture and from stuffiness in general, even before occupancy. These complaints may be due to lack of salubrity in general, but more often the failure to observe the elementary rules of hygiene in regard to the design and maintenance of heating as well as ventilating apparatus. Purity and sweetness of the air, according to the natural standard are most essential. It seems plain that room air cannot be pure if continuously or periodically contaminated by dried, cooked and partly decomposed dust lifted and carried around by hot air currents rising from dirty heating surfaces. On the other hand, direct radiation will be objectionable where it cannot be kept clean, as would be the case in certain industrial buildings, or when it cannot be placed effectively. To screen direct radiation is also objectionable, since concealed surfaces will never be kept clean in the nature of things.

The combination of heat and dust is fatal to pure air. Apparatus must be designed to avoid or reduce as much as possible such sources of contamination. This will often help where tests for carbonic acid fail to indicate the remedy, or merely call for more volumes to be supplied, possibly impure and applied at high cost, with low efficiency.

Purity may be affected also by injudicious choice and proportioning of air supply and exhaust. The latter for instance is always preferable when dealing with solid particles, which should be removed at or close to the source. Ventilation on the principle of diluting impure air is inefficient in such cases as it can never remove all of the contamination.

The natural standard thus would leave the most desirable air temperature, humidity and renewal in a given case to be determined within liberal limits, well enough understood and settled general custom and, besides, will force attention upon the hygienic requirements, which cannot be expressed in customary measures, but may be defined by a few rules.

SUGGESTIONS FOR MEETING HYGIENIC REQUIREMENTS.

1. Keep down room air temperatures by utilizing radiant heat in mild form in place of warm air currents, as far as conditions will permit.

2. Reduce warm air currents by moderate temperature, low height and shallowness of heating surfaces.

3. Distribute and locate heating surfaces according to exposure to secure even temperature.

4. Select system and heat carrier to suit structure and service conditions, to avoid cold walls and overheated air.

5. Use heating surfaces that are visible and easily cleanable, or self-cleaning.

6. Do not let decoration interfere with sanitation.

7. Avoid forming dirt corners by piping and apparatus.

8. Insist on proper regulation of heat emission in one form or another, which means also insulation of surfaces not under control.

9. Do not sacrifice heating efficiency to obtain ventilation or vice versa, do

not spoil the air supply by heating it higher than necessary.

10. Ventilate locally, as far as feasible, with regard to sources of vitiation rather than on the principle of diluting impurities.

11. Preserve the purity and sweetness of the air supply.

Whether the requirements be expressed in the customary terms or the natural standard be taken as a guide, the results will always largely depend on the mechanical perfection of the apparatus. This means assurance of proper heat delivery, when and where required, of the right volumes and temperature for the air supply and the efficiency of an exhaust system, all to be effected under varying conditions and outside influences. Most of the complaints of overheating, underheating, drafts and stagnant air will be found at bottom to be the result of poor engineering, if the failure to calculate systematically, on the basis of natural laws can be so called. Sometimes these defects are aggravated by lack of judgment and experience in advising owners, architects and builders, which is also the fault of the engineer, or whoever had attempted to play his part. When overruled on vital points, that would slight legitimate requirements and cause suffering to other people, the engineer should not be content merely to be on record, but he should fight, on general principles, for what is fair to all parties concerned. If he does not insist or resign, he connives with the unscrupulous property owner, who cares not whether his premises are safe and sanitary.

The success of a plant will depend, furthermore, on the solution of the problem from the economical point of view. The failure to boil down and to eliminate the superfluous or to strip an apparatus of all the cumbersome parts, deadweight and unnecessary capacity, is always a handicap in service and maintenance. Over elaboration is poor engineering, which should be tolerated under no conditions. Excessive cost due to unwarranted reserve parts or duplication in place of the one reliable device is retarding confidence by investors as much as those cases where the bare requirements are deliberately slighted in competition and those where the meagre funds might have sufficed, if applied to best advantage. The cost of operation should be considered, not only with a view to best investment, but in the light of what the owner can afford. Simplicity, ease of control, and the extent to which a plant is made fool-proof, are also essential. The frequent failure to work out these features often results in that disinclination of many owners to make use of the equipment, of which engineers often complain, but which in the last analysis is due to poor judgment on their part.

On fair consideration it will be admitted that actual practice still too frequently falls short of the old-established requirements and rarely approaches the ideal of reproducing nature at her best. While stipulation as to temperature and air volumes may be necessary in some cases and for some people, too much attention has been directed to the quantities, at the expense of quality in heating and ventilating, which would be developed by the consideration of the natural standard. If engineers will use but fair judgment and good sense as to capacities, take care of accurate delivery, and mechanical perfection of apparatus in general, adapt the method to the situation and insist on sanitary apparatus, there will be less need of guarantees and less question as to temperature humidity and carbonic acid tests. There will be less talk of canned air. Window ventilation will resume its legitimate time and place. It would seem, indeed, that the problems of the day are mainly for the engineers to solve.

Fresh air is air that is cool and in motion and free from odor. Its oxygen and carbon dioxide content are comparatively unimportant. Its feeling of freshness and its freedom from odor are the important things. Pure air is normal, outdoor air having the normal percentage of oxygen, carbon dioxide, nitrogen, etc. We must make that distinction between fresh air and pure air. Modern efficient ventilating systems do what they are built for—namely, keep the air pure. They do not and cannot automatically keep it fresh as well.—*Dr. Luther H. Gulick.*

The Attitude of Heating Engineers towards the New Thought on Heating and Ventilation

How the new ideas in heating and ventilation, advanced by physiologists, as well as by those in the heating profession, are viewed by engineers generally, is well illustrated in the discussion that followed the reading of a paper on "Open Windows with Mechanical Ventilation," by Ralph C. Taggart, before the summer meeting of The American Society of Heating and Ventilating Engineers.

In this paper the author stated, among other things, that in his judgment no ventilating system should be installed in which the balance of the system is appreciably affected by the opening of windows.

"We should allow the occupants of a room," continued Mr. Taggart, "some easy means of changing air conditions within the room. No matter how carefully the system is operated, it cannot meet all individual requirements, and if the opening of windows is not allowed, the simplest and, in many cases, the only easy means of controlling certain air conditions is removed."

Proceeding on this basis. Mr. Taggart considered the question of using open windows in connection with a ventilating system where air is taken from out-of-doors and where it is washed and blown through suitable ducts to the various rooms of the building. "Some engineers," he said, "maintain that if windows are opened in rooms supplied with air from a fan or blower, a large part of the air supplied by the fan will immediately pass to the rooms in which the windows are open, and that the other rooms will not receive their proper proportion of air, or, in other words, it is maintained that the distribution of the air will be seriously interfered with.

"Investigation shows that the tendency of air to enter a building through open windows is much greater than the tendency to suck air out from a room through open windows. This is due to two facts: first, a building acts to a considerable extent like a chimney; and, second, the inertia of the air, when there is any breeze, is much more effective in bringing air in through an open window than in sucking air out.

"The engineer may say, however, that it is a question of pressure and that with the ventilating system in operation the various rooms are carried under a considerable pressure. This is a mistaken notion with the ordinary ventilating apparatus. With vent or exhaust flues of any reasonable size, plus also the chances for air leakage around the room itself, it will be found in rare instances only, in a ventilating apparatus, that the pressure in any room is sufficiently above the outdoor pressure so that it may be measured by any except perhaps the most delicate of instruments. The additional flow of air, therefore, is usually very small in a room with open windows, because of any lessening of pressure within the room. In fact, with the air blowing into a room from out-of-doors, it will be found that, while the total air admitted to the room is greater with the windows open, the air entering the room from the ventilating apparatus is less, so that more air, rather than less, is left for the other rooms.

"Let us assume a room, however, in which considerable pressure is carried within the room itself, although this shows a very faulty design in the ventilating equipment. In such a case the opening of windows on a particular day when the wind is most effective in removing air from the room will cause an excess of air to enter the room from the ventilating apparatus. This excess however, is not so great as might be imagined especially if the connections in the branch flues from the main ducts to the individual rooms have some appreciable resistance, as they usually do.

"The increase in air supply varies only as the square root of the increased difference of pressure, and if in the original design the branch connections have been slightly choked so as to place the larger part of the duct resistance in these branches, the increase in air discharge into a room with open windows may be

made practically negligible. Some may say that this resistance in the branch connections is very undesirable. This is not so if the main ducts are made of proper size, so as to minimize the friction within them, and this is desirable, for the main ducts are usually horizontal ducts, and the horizontal ducts should always be large enough to be easily accessible and large enough so that the total friction resistance within the duct system is small. If the friction in the main ducts is small, the friction in the branch connections may also be small and yet large enough so that the friction in the main ducts is negligible in comparison.

"How small an increase in duct sizes is required to reduce the friction in ducts is often not appreciated. For the same quantity of air delivered the friction varies inversely as the fifth power of the diameter, so that if the diameter of a duct or pipe is doubled, its friction is reduced to 1-32 of its former value. If the duct is increased in diameter only 50%, the duct whose diameter is two-thirds of the other duct has a friction resistance more than seven and one-half times as great, or if the diameter is increased only one-fourth, the friction resistance is reduced in the ratio of more than three to one.

"It has come to be the practice in many cases in ventilating apparatus to reduce the sizes of ducts, etc., to such an extent that many of the horizontal ducts are practically inaccessible and so that the friction resistance in the apparatus results frequently in the closing down of the apparatus because of the power required to operate the fan, especially if connected to a motor taking electric current, which may cost 5 to 10 cents per kilowatt-hour. Main ducts and main branches, therefore, should be made large, while vertical branches should be properly reduced.

"If then the windows may be opened even with the ordinary fan system of heating, some one may say that the good air from the ventilating system will escape directly out of doors. Generally speaking, this is not so, and in the special instances where they occur, short circuits from the air inlets of the ventilating apparatus to open windows are usually easily rectified.

"Some, however, may say that whereas we get pure washed air from the ventilating apparatus, we get only dusty air from the windows. This is denied by open-window enthusiasts. The truth lies between these two statements. In very dusty localities there may be considerable objection to admitting air directly from out-of-doors without washing or cleaning it, but I believe there are few who will not acknowledge that we get pretty good air in summer through open windows, and if it is good enough for us in the summer it should not be rejected because of similar chemical constituents in the colder weather.

"In regard to the question of humidity, the opening of windows for admitting air may change the humidity of the air, but if it renders the room more habitable and comfortable the author sees no reason why it should not be considered an improvement.

"In regard to comfort, on the other hand, there is an element of temperature stratification of the air which seems to be stimulating and invigorating to many people. In other words, air at a dead uniform temperature is not so desirable as air in which there are some differences in temperature. This can be carried too far, however, especially with people of sluggish circulation. In so far as it is desirable it can often be obtained very easily by the opening of windows in conjunction with the ventilating system. It can also be obtained without open windows, but usually not nearly so readily.

"Open windows used in conjunction with ventilating systems in general, therefore, increase the quantity of fresh air supplied; provide means for admitting cool air; give an additional temperature control, and often furnish an easy method of adding to the possible comfort of occupants. Open windows should not, in the average case, and absolutely cannot, in a well-designed ventilating apparatus, interfere with the operation of the ventilating system."

DISCUSSION.

F. R. STILLS It is my opinion there is not a subject before this society of greater moment at this time, particularly to the engineers if not for the public good, than to start an investigation either among ourselves or in urging it upon

physiologists, to determine what is the quality of air necessary for the welfare of the human being. There are none among them who have any sound opinion on the subject. The fact of the matter is, the only method we have now for determining the quality of air is by the measurement of the carbon dioxide in the air, which has been very conclusively proven is not an exact or satisfactory measurement at all.

In early April I was invited to visit the University of Minnesota, where Professor Bass has equipped a room in one of the public schools, located in one of the worst districts of the town, considering the class of children who attend it. They are mostly made up of "river rats" from the lowlands; they are geserally very unclean and there has been more complaint about that particular school than any other. We loaned them part of the apparatus and the instruments to carry on this work, and others have loaned other parts of it. They have an air washer, temperature and humidity controlling thermostats and humidostats, and every desk in the room has a nozzle so shaped and at such an angle that each pupil, no matter what his position, whether sitting back in his chair or leaning over his deck, is directly in the flow of fresh air. Unfortunately, the apparatus was not completed in time, so nothing can be done this year. Professor Bass has no hobbies nor theories to demonstrate in this thing at all. His idea is to invite physiologists to come there. The State is paying for a portion of the expense necessary to carry on the investigations. I might add that he has also put in an ozone machine.

I was recently reading an article which appeared in one of the English engineering papers—that they are seriously considering this same problem over there. It seems to be a subject which will be very difficult to solve. This article concluded there must be something in the changes in the outside atmosphere, not present in an artificially heated building, which has an effect on the human system that present ventilating systems fail to accomplish. The air is not always of the same constituency out of doors, and it is this change from one condition to another which evidently gives us relief. We know that in our exercises and in our amusements and other habits of life, we get very tired of any one continuous steady element; it becomes monotonous and, I think, perhaps, our whole nervous system unconsciously is affected in this same way by the uniform conditions prevailing inside our buildings; there is something in this beyond the engineer; it is up to the physiologist. I think we ought to take some action or place ourselves on record in some way to induce physiologists to make an examination into this thing on a very much broader scale than ever has been heretofore attempted. We need just such assistance and then we will have a standard and know how to proceed. But as this thing is going on, with a lot of doctors saying one thing and another lot saying something else, the ultimate result will be, there won't be any ventilating business for us, if it all goes to open windows. (Laughter.) It seems absurd, on the face of it, that the doctors should take such a stand; they will advocate the open window for a well and healthy individual, and yet if you try to get a doctor to open a window in an operating room he will have a fit; he would not attempt to carry on an operation there because the dust and dirt would blow in and get into the wounds. I think the case of a patient in whom certain cuts or incisions have been made and is thus exposed to bacteria is no more critical than the constant exposure of the mucous membranes of other parts of our bodies. Some people have a very low resisting quality, either sick or well, whereas other people can throw off most anything; we have to take care of both kinds.

I think it is a very important proposition which confronts us, and I hope the society will give more than passing attention to it.

VICE-PRESIDENT HALE: Those who were at the annual meeting in January will remember the heated discussion on the floor on this very subject, mostly between the physiologists, and they have not yet decided exactly what standard they are going to set up for our consideration.

H. W. WHITTEN: I wish to add that it is not only a physiological question but largely a psychological one, largely a question of imagination as to what is good and what is bad ventilation. That feature was brought out in a conference between a committee of this society on school ventilation and a committee of the American Society of School Hygiene, in which the doctors and scientists composing the school hygiene committee expressed the unanimous opinion that mechanical ventilation as now practiced by engineers was, in the main, right and desirable, that there were certain features about it which they themselves frankly admitted they did not understand, such as for instance, the most desirable optimum temperatures, optimum relative humidity and the desirability of changes in teperature.

Contrary to the experience of the author regarding the tendency of air to enter a building through open windows rather than to leave it, a long series of observations and experiments, covering a period of five or six years, has shown me that that statement is not true, that, given an independent air supply to a building other than the windows or walls, and with the wind blowing about the building, a greater volume of air will go out of the building than will come in, due, among other reasons, to the expansion of the warm air in the building itself. If there is 50° difference between outdoors and indoors, an artificial plenum is set up and the bad air expands equally in all directions. Being rarified and seeking, by the laws of physics, to reach air of a similar density, it withstands to a considerable degree the incoming of the cold air. On the sheltered side of a building, there will be, instead of a pressure, a condition which might be called, and is called by the English investigators, a non-pressure, which superinduces the outflow of air, in addition to its natural tendency from expansion. In one case I remember, with a 15-mile wind blowing, the comparative air flow in the duct on the exposed side of the building would be represented by 4 for the inlet and by 7 for the outlet, whereas a comparison of similar ducts in rooms on the sheltered side would show the inlet represented by 8 and the outlet by 3. That might be called an average comparison.

Another thing is that the outflow from the sheltered side of a building or the movement of air within the rooms, is very largely, almost entirely above the breathing level. The warmest air is introduced several feet above the floor. The window sills are several feet above the floor. The air flow is stratified across the room and out of the windows. There is a more or less stagnated condition induced at the bottom of the room near the floor and that produces what might be called muddy bottom. CO_2 tests taken in this room have shown a large proportion of the CO_2 near the floor or up to 2 or 3 ft. above the floor, above the breathing level of the children when seated, in comparison with that in the rooms on the exposed side.

J. I. LYLE: Regarding the difference of the air admitted through open windows in the summer and in the winter, in the case of a silk mill in New York, which turned out fine silk ribbons, this mill was able to run throughout the summer with the windows open without any trouble from dirt and dust, but when cold weather came on and the people started their heating plants, the mill had trouble and they had to shut the windows and operate air washers. There is a difference in the amount of dirt in the outside air in summer as compared with winter.

I personally had an experience with an air washer where we had a complaint of deterioration. On making an examination, we found traces of sulphuric acid in the air. The water used in the washer was analyzed, and was found to be perfectly good, but there was sufficient sulphur being taken out of the smoke in the surrounding atmosphere to charge that water rather heavily with sulphuric acid during a week's run. There was a good deal more trouble of that kind in winter than in summer.

F. L. WILLIAMS: I think a great deal of the window-opening agitation has been due to the use of the old system of gravity ventilation. There is no question that if you open the windows with a gravity system, the system is immediately affected. The stacks will not pull as

well, and I have found this true sometimes with fan systems of ventilation.

I am somewhat of a crank on the double fan system of ventilation. With a proper system of ventilation, the opening of the windows has very little effect. Many a time in buildings equipped with a double fan system, without a strong outside wind pressure, I have placed an air meter on the window sill and opened the window wide and the air meter has not even turned. I have made that experiment so often that I cannot be mistaken. We have wholly devoted ourselves in the direction of double fan systems.

However, as engineers, we cannot deny the fact that artificially heated air is different from outside air. I have had chemical tests and analyses made of air in rooms which showed exactly the same amount of carbon dioxide as was contained in the outside air, but when we passed from that room that had practically pure air to the outside, there was a wholesomeness in the outdoor air that we did not find inside.

I believe the time is coming when we will reoxygenize the air after it is heated. This has already been done in the tunnels of London.

Heat Transmission Through Building Walls of Corrugated Iron

The modern tendency to construct shops and manufacturing establishments with large window areas, the concrete or steel frame often forming little more than a grid for the windows, has directed much attention to the calculation of the heating requirements of such buildings. In the case of the heat losses through building walls of corrugated iron, an interesting opportunity was afforded for determining these losses in connection with the new fan shop of the Green Fuel Economizer Company, of Matteawan, N. Y. The walls and roof of this structure, which is devoted to the manufacture of fans and blowers, consist solely of glass and corrugated iron.

During the construction of the building it was noticed that there was no authentic figures on the rate of heat transmission through corrugated iron. On this account, the builders were prepared, if necessary, to line the building, if a comfortable temperature could not be maintained otherwise with a moderate expenditure of heat. To their surprise, however, the loss of heat from the building was found to be not excessive. This is explained in part by the fact that considerable care was taken in the construction of the building to avoid air leaks, the crevices under the eaves being carefully plugged with asbestos and the bottom courses of the sheathing being cemented into the floor.

Aside from this, physical theory indicates that the heat transmission through corrugated iron should not vary greatly from that through a single thickness of glass and the tests apparently show this to be the case.

The shop measures 225 ft. long by 48 ft. wide, with an average height of 32 ft. There are continuous windows on one side 15 ft. high and on the opposite side, 19 ft. high. Otherwise, the building is covered with corrugated iron of single thickness without lining. Measures were taken to make the building as air tight as possible, as already stated. The exposure of the windows is east and west, the smaller windows being on the east side.

The coefficients given by different authors for the rate of heat transmission through single windows vary somewhat. Prof. Homer Woodbridge gives for single windows with a southern exposure, a coefficient of 1 B.T.U. per square foot per hour per degree difference in temperature between inside and outside. For northern exposure he suggests adding 35%, for eastern exposure 15% and for western exposure 25%. Ludwig Dietz, quoting Dr. Rietschel, of Berlin, and also the specifications of the Prussian Government, gives for single windows 1.026, and Dr. Rietschel suggests increasing this 10% for northern exposure or northeasterly or northwesterly exposures, and

10% for especially strong winds. The only figure for corrugated iron without sheathing that has been found is one by Rietschel of 2.132, but without any statement as to whether this refers to superficial wall area or to the actual surface of the iron.

Various attempts have been made to analyze the coefficient of heat transmission from one fluid to a solid substance and from the solid to a second fluid. The formula commonly employed is of the form,

$$k = \frac{1}{\frac{1}{Ai} + \frac{1}{Ao} + \frac{x}{e}}$$

Wherein Ai is the transmission from the inside fluid to the wall surface and Ao is the coefficient of heat transmission from the outside wall surface to the second fluid, e is the conductivity of the material in heat units per square foot per hour per degree difference per inch of thickness and x is the thickness in inches.

For the value of Ai and Ao Grashof gives the following equation:

$$a = c + d + \frac{(40\,c + 30\,d)\,T}{10{,}000}$$

In which c depends upon the velocity of the fluid. Rietschel gives for air at rest

$c = 0.82$

In slow motion, as in contact with cold windows.

$c = 1.03$

In rapid motion, as outside of buildings,

$c = 1.23$

d for glass is given as 0.60 and for sheet iron as 0.57

T for single windows is given as 36, no value being given for iron.

Calculating from the above values, we find that for a single glass window Ai is 1.84 and Ao is 2.07. For sheet iron the value for Ai is 1.81 and for Ao 2.04.

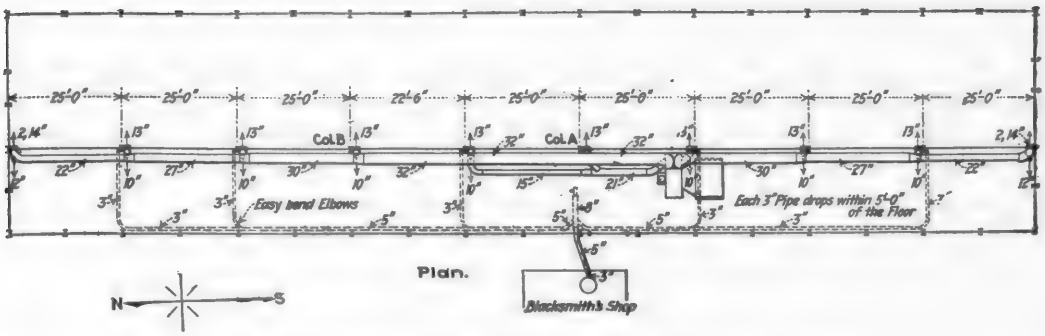
VIEW IN THE FAN SHOP OF THE GREEN FUEL ECONOMIZER CO., MATTEAWAN, N. Y., SHOWING LOCATION OF FAN, HEATER AND AIR DUCTS.

For e Rietschel gives 190 for iron and 6.6 for glass. It will, therefore, be seen that the third term in the denominator of the expression for k can be neglected for iron and is practically negligible for glass.

Using the values of Ai and Ao just found, k for a single window works out as 0.958 and for a single thickness of sheet metal as 0.955, practically the same.

EFFECT OF CORRUGATIONS.

This, however, is not taking account of the additional surface of the sheet metal wall due to the corrugations. The cor-



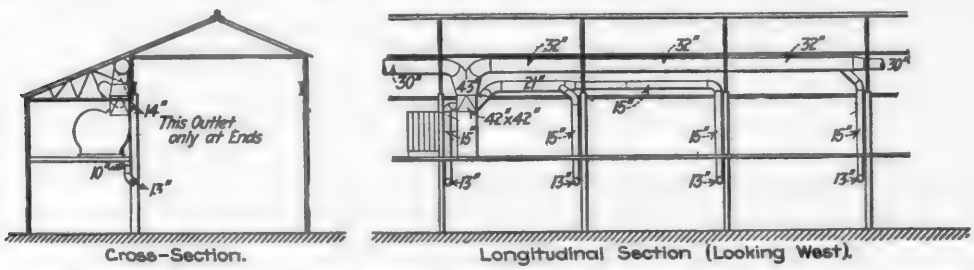
PLAN OF BUILDING UPON WHICH TESTS WERE MADE.

rugated metal used in the building under discussion has one corrugation to every 2½ in., the depth of the corrugation being 1 in. The actual surface of the metal is approximately 1.35 times the superficial area. This would make the rate of heat transmission for corrugated sheet iron, figured on the basis of superficial area, approximately 1.35 times 0.955, or 1.29

The values obtained by Grashof's method for both glass and sheet iron are thus seen to be lower than the values used in ordinary practice. This may possibly be explained on the hypothesis that the constants used in ordinary practice have been increased to account for losses due to leakage, the opening and shutting of doors, etc. Weight is lent to this view by the results of the tests which follow, bearing in mind that the construction of the present building makes it practically air tight. At the same time the values obtained were slightly greater than Grashof's formula would call for. Any close agreement is, of course, not to be expected, as the sheet-metal-working machinery and shafting housed in the building were in constant operation during the test, producing heat which was not measured, while on the other hand doors were being opened for the passage of men and materials on an average of once every ten minutes.

TEST CONDITIONS.

The total surface of the building is made up of approximately 7,538 sq. ft. of window, including the sash, 8,247 sq. ft. of wall surface and 11,925 sq. ft. of roof, the walls and the roof being given in superficial area. The total of wall and roof areas is 20,172, which, increased by the factor 1.35 to account for the corrugations, gives 27,130 sq. ft. total metal surface. The total superficial expanse of the building is 27,710 sq. ft., and the total actual surface, counting the metal in the corrugations, is 34,658 sq. ft.



LONGITUDINAL AND TRANSVERSE SECTIONS OF BUILDING ON WHICH TESTS WERE MADE.

The building is heated by a Green's hot-blast heater, consisting of an engine-driven centrifugal fan drawing through a "Positiv-flo" heater made up of six sections of four rows of pipe each, the sections measuring 7x8 ft. The heater is ordinarily drained of condensate and air by a Dexter vacuum system. There are altogether 6,816 lineal feet of 1-in. pipe in the heater, or 2,272 sq. ft. of heating surface. The air is distributed throughout the shop by circular sheet iron conduits with outlets directed down into the zone occupied by the workmen.

The fan and heater had been running for about 2 hours when the first readings were taken at 8:30 A. M. and the temperature of the shop was maintained constant until readings were discontinued at 11:30 A. M.

During the test the fan was run at 258 R.P.M., receiving 22,416 cu. ft. of air per minute, figured to 50° F., the air actually being received by the heater at 73° F. and delivered from the fan at 156° F. The temperature of the steam in the heater was 212° F. The temperature of the air delivered from the farthest outlet was found to be 141½° F. Under these conditions, the temperature of the building, measured 3 ft. from the floor, was 66°, and measured in the gallery, 70°, the temperature out of doors being 15° F.

DETERMINING THE TOTAL HEAT SUPPLIED.

For the determination of the total heat, two methods were employed. First it was calculated from the amount and rise in the temperature of the air passed through the heater, and secondly, from the condensation in the heater. For the latter purpose, the steam pipe from which the steam was introduced to the heater was carefully drained and the condensate from the heater was weighed. Figured by the air method, the consumption of heat was 2,084,000 B.T.U. per hour, and by the condensate method, 2,029,730 B.T.U. per hour.

Using the air figures, we find that the average rate of heat transmission through the superficial area of the building, that is, not counting the corrugations, was 1.42 B.T.U. per sq. ft. per hour per degree difference, and using the steam value, 1.38 B.T.U.

If we take Prof. Woodbridge's figures for the rate of heat transmission through the windows, we would have for a window on southern exposure, 1 B.T.U. per square foot per hour per degree difference, which, however, is to be increased 15% for eastern exposure and 25% for western exposure, or in the present case, an average of approximately 20%. Figuring the window surface as 1.2, the value for the corrugated iron, figuring superficial area only, is 1.5, or figuring the whole surface of the iron, 1.13, that is less than an equivalent amount of glass surface. This hardly seems likely, although it may be possible, the explanation in that case being, perhaps, that the corrugations in the iron protect the surface to a certain extent, that is, that the rate of heat transmission per square foot of actual surface through corrugated iron is less than it would be through a flat iron surface.

If we take the value obtained by Grashof's method for the glass windows, namely, 0.958, the value for the actual iron surface comes out at 1.19, but on the basis of this formula, there would be no reason for expecting any such difference between the iron and the glass.

Allowing for the many undeterminable conditions, it would probably be safe in calculating the heat supply for buildings of this kind to provide for a coefficient of transmission of 2 B.T.U. for the whole wall and roof area.

The coefficient of transmission through the surface of the hot blast heater in this test was 9.41 B.T.U. per square foot per hour per degree average difference in temperature between the air and the steam, figured by the ordinary arithmetical method in which the average difference in temperature between the steam and the air is assumed to be the difference between the steam temperature and the mean of the air temperature on entering and leaving.

Figured according to the logarithmic formula, which takes account of the fact that the air rises more rapidly in temperature in passing over the first rows of tubes than in passing over the later rows of tubes, the value is 10. The mean physical velocity of the air through the heater was 1,210 ft. per minute.

In a subsequent test, with air entering at 72° F. and leaving at 166° F. and steam at 213° F., in which the velocity of the air was 760 ft. per min. a coefficient of transmission of 7.5 (logarithmic) was obtained. 10 and 7.5 are in the ratio of the 0.64 powers of the respective velocities, that is, the coefficient did not vary directly as the velocity, as frequently asserted. If instead of mean velocity we use flow in pounds of air per minute through the heater, which amounts to the same thing as velocities reduced to a standard temperature, the coefficients are found to be in the ratio of the 0.62 powers of the rates of flow.

Time Required to Heat a Radiator

FIGURED ON THE BASIS OF LIMITING THE HEAT SUPPLY TO THAT REQUIRED WHEN ROOM TEMPERATURE IS AT 70° F.

BY JAMES A. DONNELLY.

Further calculations of the time element in heating apparatus were brought out at the recent mid-summer meeting of the Heating Engineers' Society in a paper by James A. Donnelly. His previous contribution to this subject was published in THE HEATING AND VENTILATING MAGAZINE for May, 1912, and included some recording temperature records showing the time actually taken to bring up the indoor temperature to normal in the cases of two buildings of different types of construction, as well as cooling curves for the same buildings.

In reviewing the subject Mr. Donnelly stated that the time element of a heating apparatus as a whole may be defined as the time elapsing from the initial firing of a plant at any given outside temperature to the moment when the temperature of the building has been raised to that for which the apparatus was designed. An analysis of the subject might be divided into a consideration of the time required to heat a radiator or other part of an apparatus which has been shut off and allowed to cool (the time required to heat up the piping, radiators, etc., after the fire has been banked over night); and also a consideration of the comparative time required in bringing a steam, hot water or hot air apparatus to its maximum temperature. The time element may also be considered in the light of the cooling curve of the apparatus or the building. In all calculations of this character, the higher mathematics give exact results, but for an easy understanding of the subject approximate calculations will be considered sufficient for all practical purposes.

Calculating the time necessary to heat an individual radiator can best be done by considering one in which the maximun opening of the supply valve is supposed or intended to be just sufficient for the normal heating of the radiator at the pressure designed when the room is 70°. With this opening and under the given pressure, no steam is supposed to pass to the return, but only water of condensation. Assuming the ayerage cast-iron radiator to weigh 7 lbs. per square foot of surface and the specific heat of the iron being 0.13, it will take $7 \times 0.13 \times 150 = 136.5$ B. T. U. to raise the temperature of the radiator from 70° to 220°. If the radiator gives off 250 B. T. U. per square foot per hour when fully heated, or 4.1 B. T. U. per minute, the mean emission from the radiator per minute during the time of heating the radiator (starting at 70°) will be one-half the amount, or 2.05 B. T. U. per minute. Thus, while the supply of heat to the radiator is at the rate of 4.1 B. T. U. per minute, 2.05 B. T. U. on the average are emitted to the air, leaving the remainder, or 2.05 B. T. U., to serve for bringing the iron up to temperature.

In the instance cited it will accordingly take $136.5 \div 2.05 = 66\frac{1}{2}$ minutes to heat the radiator. In other words, if we divide the number of heat units required to heat the metal of a radiator by the supply of heat available per minute for the purpose, the quotient is the number of minutes required for the operation. The available supply per minute is the number of heat units represented in a minute's supply of steam diminished by the mean number of heat units transmitted through the outside of the radiator to the air. If we let I represent the amount of heat required to heat the radiator and R the amount of heat brought to the radiator per minute and E the mean amount emitted per minute, then the number of minutes required to bring the radiator to temperature, M, is equal to $I \div (R-E)$.

HEAT EMISSION NOT CONSTANT FOR WIDE RANGE OF TEMPERATURE DIFFERENCES.

The foregoing brief analysis is rather too approximate, as the rate of heat emission is not constant for a wide range of temperature differences. For example, when the mean temperature difference between the air and the metal of the ra-

diator is, say, 10°, the heat emitted, according to tables available on the subject is 0.55 B. T. U. per degree per square foot hourly, while if the difference is as much as 150°, the coefficient is no less than 1.64 B. T. U. per square foot per degree per hour. Accordingly, we may make a more extended analysis for the same conditions and find that, as a matter of fact, it will take hours for the radiator to get up to steam temperature, depending on how quickly the air surrounding the radiator becomes warm.

Indeed, if conditions were such that the air outside the radiator remained at some low temperature, say 30°, the radiator would never fully come up to temperature, assuming, of course, that it is supplied with no more than the normal amount of steam it is expected to condense with the ambient air at 70°.

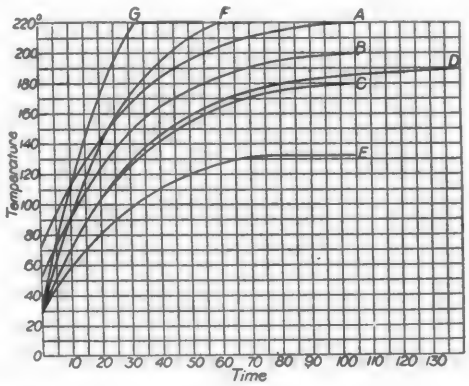
Suppose the radiator is located in a room with the air at 30°, and the steam is then turned on at the rate to supply the so-callen normal amount, namely that equivalent to about 250 B. T. U. per square foot per hour. Then for every minute that the radiator is in operation it receives 4.1 B. T. U. Suppose that the radiator has become warmed to 50°, and the temperature of the air has not been measurably increased. The mean difference in temperature between the radiator and the air is 10°. As the transmission of heat to the air for this temperature difference is about 0.55 B. T. U. per hour for the entire time that the radiator is in operation under this average temperature difference, the radiator loses to the difference between the heat supplied and the heat given to the air is therefore for every minute 4.1—0.09=4.01 B. T. U.

As the radiator has in the meantime been warmed to 50°, this difference of heat has been stored in the radiator and is equal to 7×0.13×20—18.2 B. T. U. As the amount of heat available for storage in the radiator is 4.01 for each minute, it is obvious that the number of minutes required to warm the radiator is 18.2÷4.01=4.54 minutes.

WHEN RADIATOR IS HEATED FROM 50° TO 70°.

In the same way we can imagine the radiator warmed from 50° to 70°. We can then assume that the air has by this time reached 31°. The mean temperature then between the radiator and the air is roughly 29.5°. From tables of heat transmission from radiators we can assume a value of 1.18 B. T. U. per degree per square foot per hour for the transmission, and, proceeding as before, we ascertain that the number of minutes required to warm the radiator from 50° to 70° is 18.2÷(4.1—29.5×1.18÷60)= 5.17.

By taking successive steps and allowing for a gradual increase in the surrounding air, successive values of the time interval may be calculated. For example, we may assume that by the time the radiator has reached 150° in temperature the air is 35°, and then that each square foot of the radiator or a given



TIME IN MINUTES REQUIRED TO HEAT A COLD RADIATOR.

square foot of the radiator is warmed to 170°, with on increase in air temperature of 36°. Here with a mean temperature difference of about 124.5°, and a corresponding coefficient of heat emission of 1.55 B.T.U., the number of minutes works out to be 20.7. So long as the difference in temperature between the radiator and the air is less than 150°, which difference is that for assumed normal operation, the radiator can continue to warm up toward steam temperature.

While extended figuring along these lines is of no importance *per se,* it goes far to show how important a factor the initial warming of a heating apparatus may be. For example, pursuing the figures but a step further, they indicate that even allowing the air to take on 4° (from 36° to 40°, in other words) while

warming the radiator from 170° to 190°, the time required to accomplish this increase figures out at 70 minutes, so great is the amount of heat constantly going into the air from the radiator in relation to the total amount supplied in the same time.

RESULTS OBTAINED WITH STATIONARY INDOOR TEMPERATURE.

To bring out the point a little more clearly, accompanying curves are presented. Curves A, B and C show the time required to warm the radiator when it is started at a temperature of 70°, 50° and 30°, respectively, the air remaining at these temperatures. They would indicate that instead of the radiator reaching the steam temperature in an atmosphere of 70°, within shortly over 60 minutes after turning on the steam, as the first rough calculation showed, it would take over 100 minutes. Curve B shows that with the air remaining at 50°, the temperature would not pass 200° on the average, the difference between the air nd the radiator being the 150° menoned. All the iron would be heated to a temperature which would correspond to an average of 150°. Curve C indicates in a similar way that the air remaining at 30°, the radiator would not pass 180°.

ALLOWING FOR GRADUAL INCREASE IN INDOOR TEMPERATURE.

Curve D is one allowing for a gradual increase in the air temperature. In this particular case it is the curve for the heating up of a radiator starting at 30°, and allowing for a gradual warming of the surrounding air. It will lie to a greater or less extent above Curve C, according to the rapidity with which the surrounding air is itself warmed. It will continue on the upward rise until, of course, the radiator assumes steam temperature. Curve E corresponds to Curves A, B, and C and is for a hot water radiator starting at 30°, in an atmosphere remaining at that temperature and allowing for 100° between the air and the radiator temperature under normal conditions. Curve F is drawn for a steam radiator started at 30°, with the air remaining at 30°, but the steam supply one-half again greater than the normal supply. Curve G corresponds to the conditions of Curve F, except that the steam supply is double the normal.

DISCUSSION.

E. A. MAY: The author states that with 2 lbs. steam pressure in the radiator, the temperature of the iron in the radiator was 220°. The conduction of iron is well-known and if the radiator, under these conditions, emitted 250 B.T.U. per square foot per hour, it would mean a temperature difference between the two faces of the radiator of only 0.6. It is well-known, too, that the temperature of the iron in a radiator does not approximate the temperature of the steam, otherwise there would be no transmission of heat from one to the other. The outside wall of a radiator is, by actual measurement, but little higher in temperature than the surrounding air. I should like to know by what means the author obtained the temperature of the inside wall of the radiator. In most testing methods it has been a difficult matter to measure this.

MR. DONNELLY: If Mr. May has those data available, that the outside wall of a radiator is but little higher in temperature than the surrounding air, I would say that this fact has escaped me thus far.

MR. MAY: The government has published a brochure on the conduction of heat through the walls of a firebox, containing reports of a series of experiments showing a very rapid drop in temperature. I do not think that with 2 lbs. gauge pressure in a radiator, the temperature of the walls will be 220°.

MR. DONNELLY: In my experiments, I took a radiator and gave it a steam supply to bring it up to the desired temperature and then caught the condensation. It figured 0.13 as the specific heat of the iron. I had no way of getting the temperature of the radiator except by the condensation, but either 0.13 is incorrect as the specific heat of iron or the entire iron in the radiator does come very close to the steam temperature.

D. M. QUAY: I do not think it is impossible to have the outside of a radiator the same temperature as the inside, especially with a cast-iron radiator, until you get the temperature of the room up to the temperature of the steam inside the radiator, which is scarcely possible. I think you will find that the outside wall of a radiator is nearer the temperature

of the surrounding air close to the radiator than to the steam in the radiator. It might be possible with very thin sheet metal or some similar material to have the outside wall of the radiator nearly the same temperature as the inside wall. It is claimed that the temperature of the water of condensation in the radiator is from 7° to 10° lower than the steam entering the radiator.

MR. DONNELLY: In all radiator tests the temperature of the room, 70°, subtracted from the temperature of the steam, or 220°, gives us 150° difference. This transmission is given in all the tables of transmission as B.T.U. transferred per hour per degree, and the total B.T.U. conducted from the radiator is then divided by 150. Now, it is true that the outside of a radiator is only 70° or 80°.

About three years ago, I suggested a method of arbitrarily subtracting 20° from the temperature of the steam before dividing by the difference in temperature. Just from a variable coefficient of transmission to a constant, it increased the coefficient of transmission 2½ B.T.U. It is our ordinary practice to take 220° — 70°. If you take 20° from the steam temperature, it would make 200° — 70°, or 130°, which, multiplied by 2.5, gives the B.T.U. transmission.

Following are the figures by which it was determined that the entire radiator was heated up to or very close to steam temperature:

Size of radiator, 20 sq. ft.; weight, 130 lbs.; temperature of steam, 215° F.; temperature of room, 75° F.; weight of condensation for 10 mins., 2.94 lbs.; less normal condensation for one-half this time (figured at 0.25 lbs. per hour) 0.25 + 20 ÷ 12 = 0.48 lbs., leaving 2.46 lbs. as the condensation due to raising temperature of the iron from 75° to 215°.

Therefore, 2.46 lbs. condensation multiplied by 963 B. T. U. per pound equals 2,368.98 B. T. U. added to the iron. This divided by 130 lbs. and multiplied by 140° rise in temperature (equals 18,-200) gives a quotient of 0.1301 as the specific heat of the radiator. The steam was assumed to be commercially dry as it was taken from a separator, but may have contained a slight amount of moisture.

Perhaps if tests made in this manner with accurate instruments and careful observation were repeated by others, a more definite result could be obtained as to the exact temperature of the radiator.

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*Removal of Refuse and Waste by Fans and Blowers**

BY F. R. STILL.

The removal of waste material from machines in industrial plants by means of fans or blowers has been in general use for over 70 years. It is the most efficient and satisfactory method known; yet even now the minimum velocity or volume of air required to convey substances of varying specific volumes and densities is not known to any definite extent.

The application of exhaust fans to the handling of refuse probably dates back to soon after the invention of woodworking machinery. In the early days it was necessary to do considerable experimenting to determine the correct sizes of pipes to attach to machines of the varying types and capacities. Naturally little was known about the proper design and proportion of hoods, so considerable confusion existed for years as to the proper pipe sizes. But in due course of time a standard size of pipe was generally adopted for a given duty on a machine of a certain type and capacity, and these sizes have become almost universal.

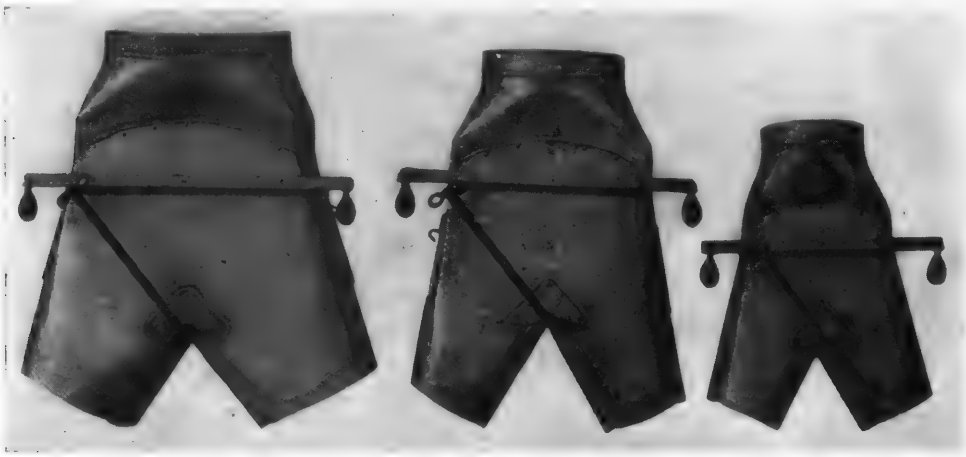
The way these sizes were arrived at was very crude. In those days (and even by some at the present time), it was generally supposed that the pressure pushed the material along. Nobody thought it was the velocity, and even if they had thought of it, they had no known method of measuring the velocity as an anemometer would be quickly destroyed at such high velocities. The Pitot tube for measuring velocity was

*Read at the recent summer meeting of the American Society of Heating and Ventilating Engineers, in Detroit, Mich.

not generally understood, and, in fact, it is only within the last five years that it has been developed to an extent that makes it an accurate or dependable instrument of measurement.

WHY ART IS NOT ON MORE SCIENTIFIC BASIS.

A large part of the business has been in the hands of small concerns generally known as blow pipe makers, many of whom are chiefly tinsmiths. They have not the engineering talent, capital nor initiative to take up the work of experimentation and investigation. As for the fan manufacturers, most of them have been too busy experimenting and developing larger and more profitable fields of usefulness to devote any time to it.



EQUALIZING OR DISTRIBUTION DAMPERS UNDERNEATH SEPARATOR FOR THROWING SHAVINGS AND DUST ON TO FURNACE GRATES OR INTO SHAVINGS VAULT.

Last summer a student in one of our larger universities spent his vacation in the office of a blower manufacturer. Before returning to finish his senior year he asked what would be a good subject to take up for his thesis. It was suggested that he set up an experimental plant and investigate the conveying of various substances by fans and blowers. This is undoubtedly the first time a thorough and systematic research into this all-important subject has been attempted, outside of the fold of those who make and sell the equipment.

It is to be hoped this start will lead to a wider investigation, as it is certain that if one-tenth of the time is spent upon it that has been spent on other things which have less promise of economic results, a great good will have been accomplished in almost all lines of manufacture. There is hardly an industrial plant but has one or more fans thus employed requiring from 25 H. P. up to, frequently, several hundred horse power to drive them. It is all the more important that the work be taken up by our universities at this time, as most of the fan manufacturers have given up contracting for the installation of such plants and are less likely than heretofore to do much investigating. Further, as time goes on, there will be all the more need for it, due to a general conservation of resources, which simply means greater economy and higher efficiency.

MATTERS TO BE DETERMINED.

These investigations and experiments should first determine what velocity is required to move different substances of varying weights and bulk. Then should be determined what proportionate volume of air is required to move in a unit of time a specific volume of different substances having varying weights and bulk. Air pressure is only a measure of velocity and resistance, beyond which it has nothing to do with the moving of material, as many suppose.

The relative area of a substance has a great deal to do with the ease with which it can be moved by air. For instance, a comparatively low velocity will move a cubic foot of powdered coal which will

pass through a 100-mesh wire screen. It will take double the velocity to move a cubic foot of coal which will pass through a 25-mesh screen. But a centrifugal fan cannot produce high enough velocity to move a cubic foot of coal in a solid block.

The same is true of many other substances; take for instance shavings and dust from planing-mill machinery.

TYPES OF BUFFING HOODS FOR GRINDING WHEELS.

Twenty feet per second will move the lighter dust; 40 ft. will move the shavings; 50 ft. will move the sawdust, but there are knots, blocks, etc., which also have to be taken care of, and these sometimes require 60 ft. or more per second. Hence the velocity has to be selected which will take care of the largest and heaviest pieces likely to enter the system.

From this it will readily be seen how essential it is for economical operation to know what is the lowest velocity required to move a given substance, as the frictional loss multiplies directly as the square of, and the power to drive the fan directly as the cube of the velocity. For example: if only 40 ft. per second is necessary and 80 ft. is provided and at the lower velocity it requires 25 H. P., it would require 200 H. P. at the higher speed. This is not an absurd comparison, as many are the plants where just such a comparative waste of power is taking place.

Frequently the velocity as predetermined may be correct, but the volume of air for the volume of material to be handled in a given unit of time may be insufficient. In other words, the ducts are too small. Hence the fan has to be speeded up to create a higher velocity in order to move the requisite volume of air. This has exactly the same effect on the power as would the velocity if it had been figured too high at first.

HOW TO LAY OUT EXHAUST FAN SYSTEM FOR A WOOD WORKING PLANT.

To lay out an exhaust fan system for a wood-working plant, it is necessary to have a plan of the shop showing the location of each machine, the position of all line shafts and counter shafting, with direction of rotation indicated, the location of the boiler room, shaving vault and the available space for locating the dust separator. With this in hand, a list of the different machines should be made up, with the number of heads, length of knives, speed of feed of each, also the diameter of all saws and whether rip or cut-off saws. The number and position of all floor sweeps must also be predetermined.

Next one should map out the general scheme for the piping system, being guided by the following considerations in the order in which they are given:

1. The most convenient place to pipe the fan.

2. The most convenient place to drive the fan.

STYLE OF HOOD FOR BAND SAW, SWING CUT-OFF SAW, ALSO SPECIAL BLAST GATES.

3. The most convenient place to give the most direct line of discharge to the final receptacle.

Next in order is to determine the sizes of the branch pipes to each machine, which can be done by the aid of Table I,

as this gives the standard diameters to attach to the hoods enclosing the knives and saws of ordinary machines.

TABLE I.

SIZES OF PIPES FOR PLANING MILL MACHINERY

UPPER CYLINDER

Length of Knives, In.	Diam. of Pipe, In.
5	4
10	5
14	6
24	7
30	7

LOWER CYLINDER

Length of Knives, In.	Diam. of Pipe, In.
5	4
10	5
14	5
24	6
30	7

	Diam. of Pipe, In.
Matcher heads, each	5
Sash and cabinet shaper, each head	4
Door tenoner	5
Sash tenoner	4
Door and sash sticker, each head	4
Blind slat sticker	4
Blind rail router	4
Panel raiser, each head	4
Sand drum, 24 in. long	4
Sand drum, 30 in. long	5
	Diam. of Pipe, In.
Mortiser, floor spout	6
Floor sweep-up	6
Rip saw and re-saws	
10 to 16 in. diam	4
18 to 24 in. diam	5
42 to 60 in. diam	6
Cut-off and grooving saws	
10 to 16 in. diam	4
18 to 24 in. diam	5
Band saws, small	3

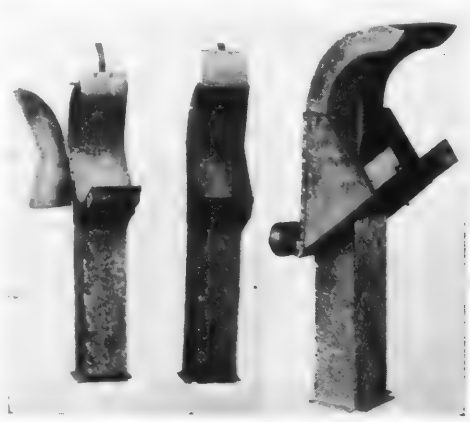
Molders, buzz planers, pony planers, diagonal planers, jointers and all other machines having knives or saws of dimensions given will require pipes of their respective diameters. Timber planers require 25% larger pipes than ordinary planers. High speed planers and matchers require about 50% more area than is indicated in above table.

On the plan mark the sizes of the various branches; then add these areas together whenever two or more pipes join and find the resulting diameter of the main. Continue this process until every branch is taken care of back to the fan, which finally determines the minimum diameter of the fan inlet.

If the fan selected is a size or two larger than the sum of the areas would indicate, it will do the work when running at a very much slower speed, and will require less power. For example, supposing the plant requires a 12-in. main, which with the branches and separator offers a resistance of, say, 4¾-in. water gauge. If a fan having a 12-in. inlet should be attached it would have to run at about 1,865 R.P.M., requiring 5⅞ H.P.; whereas, if a fan having an 18-in. inlet were attached to produce the same velocity, it would only have to run at 1,040 R.P.M., requiring 5¼ H.P. Thus the speed would be reduced 44% and the power reduced more than 10%.

DETERMINING SIZE OF DUST SEPARATOR.

Having determined the size of the fan the next in order is to determine the size of the dust separator. The purpose of a separator is to remove the shavings and dust from the air blast, delivering the former into some convenient receptacle or on the grates beneath the boiler, allowing the air to escape freely with little



SPECIAL HOODS FOR EMERY GRINDING WHEELS.

or no pressure or resistance into the atmosphere.

All the separators on the market, save one make, employ centrifugal force to accomplish the separation, the one exception depending upon centripetal action. Every maker of separators sets up great claims for his particular device and some do work better than others, but, more often than not, the real difference in the results obtained, if there is any, is due to differences in engineering. Table II gives the principal dimensions of one of the standard makes of cone bottom separator. Any other good separator of this type will not be very much different in its proportions.

TABLE II. PROPORTIONS OF DUST SEPARATORS.

No. and Diam. of Inlet.	Openings: Size of Inlet, in.	Openings: Diameter Air Outlet, in.	Openings: Diameter Dust Outlet, in.	Dimensions: Outside Diameter Cylinder, in.	Dimensions: Height Cylinder, in.	Dimensions: Length Cone, in.	Approximate weight, lbs.
5	2½x 9	8½	3	29½	14	26½	70
6	3 x10½	10	4	35½	15½	32½	100
7	3½x13½	13	6	41½	18½	37½	140
8	4½x16	15	6	47½	21	43½	175
9	5 x18	17	6	53½	23	50	245
10	5½x21	20	10	59½	26	56	315
12	6½x24	23½	10	65½	29	61½	395
13	7 x27	26	10	71½	32	67½	490
14	8 x30	28	10	77½	35	72½	575
16	8½x32	31	10	83½	38	77½	715
17	9 x35	33	10	89½	41	82½	875
18	9 x40	36	10	93½	46	85½	930
20	10 x41	39	10	97½	47	89	1,000
22	10½x43	41	11	101½	49	93	1,095
23	11 x45	44	11	105½	51	97	1,455
24	11 x48	46	12	109½	54	99½	1,600
25	11 x51	49	12	113½	57	103½	1,700
26	11½x54	52	12	117½	60	109½	1,855
28	12 x57	55	12	121½	63	111½	2,035
30	12 x60	58	12	125½	66	115½	2,155
32	12½x63	61	13	129½	69	118½	2,250
34	13 x66	64	13	133½	72	122½	2,420
36	13½x69	67	13	137½	75	126½	2,555
38	14 x72	70	14	141½	78	129½	2,745
40	14½x75	73	14	145½	81	133½	2,900
42	15 x78	76	14	149½	84	137½	3,065
44	15½x81	79	14	153½	87	141½	3,235
46	16 x84	82	14	157½	90	145½	3,395

The above recommendations apply to shavings, but not to light buffing dust, etc., for which the separators must be selected to suit operating conditions.

Table III gives the dimensions of another type known as a flat bottom separator, patented and owned by a Grand Rapids concern. It works well, has the advantages of being only about two-thirds the height of the other types, and is, comparatively, very easy to erect.

The centripetal type of separator referred to is made by a concern in Minneapolis. The dimensions of it do not vary to any great extent from the dimensions in Table II. The discharge pipe from the fan connects into the central opening in the top, where the air usually escapes from most separators.

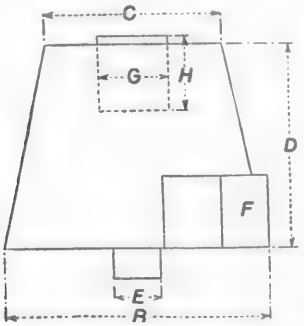
A good separator should not set up a resistance to the flow of air, which is in excess of the velocity head due to the flow. In other words, if the air velocity is 60 ft. per second in the discharge pipe, the separator should not offer a resistance that will increase the discharge pressure more than 0.81 in. water gauge. All makes of separators are regularly built either right or left hand.

The proper form, proportion and construction of the hoods are the most difficult to deal with on paper, of any part of an exhaust fan system.

To make a thoroughly good and efficient hood is an art. It requires the best skill of an experienced tinsmith. Of course most anything can be made to work after a fashion, but to construct a hood that does a clean job and does not require an excessive velocity or volume of air is something known to but few mechanics, very few of whom are outside the employ of concerns making a specialty of such work.

Hoods are never carried in stock by anybody, there being such a variety of makes and sizes of machines as to preclude the possibility of making a standard to fit one make of machine that will fit any other make. A governing principle for the design of hoods is to so shape them that the refuse from the knives or saws is thrown directly to a point where it will be caught by the highest velocity of the air.

The hood over the upper knives on a surfacer has a mouth at the bottom several times the area of the pipe; consequently it has very little lifting power at the mouth. Immediately above the apron around the knives, the hood is drawn in from all four sides so as to reduce the area to about equal the pipe area; it is also drawn back at a considerable angle in the direction the shavings



PROPORTIONS OF STANDARD VERRALL COLLECTORS.

fly from the knives. Thus the shavings fly at once into the contracted area where the velocity is the highest and, being once set in motion, it is easy to keep them moving.

The hood to the bottom knives is not much more than a shallow hopper with a narrow slit at the bottom leading into a horizontal pipe. The end of the pipe is usually left open to prevent clogging up, as otherwise if the shavings should bridge over the opening in the bottom of the hopper, it would shut off all circulation and the pipe would then become dead until cleaned out. The hoods to the side are sometimes very complex in form, but the same principles are employed in their design as for the upper hoods.

Where the branch pipes attach to the main, they should enter at an angle of not more than 45°, and 30° or less is better. Never attach a branch at right angles to the main. Two branches should never enter the main directly opposite one another; also avoid the use of Y-branches, as the two currents in conflict retard the flow, sometimes causing the pipes to clog.

Elbows should have a radius in the throat twice the diameter of the pipe. For example, a 6-in. pipe should have a radius of 12 in. in the throat. There is no advantage in making the radius more than twice the diameter.

A right-angle elbow in a 6-in. pipe offers as much resistance as a straight pipe of the same diameter 44 ft. long.

With a radius of half the diameter, it is equal to a straight pipe 15 ft. long.

With a radius of one diameter, it is equal to a straight pipe 5½ ft. long.

With a radius of two diameters, it is equal to a straight pipe 2¼ ft. long.

TABLE III. PROPORTIONS OF STANDARD VERRELL COLLECTORS.

No.	Diam. Pipe from Fan, in.	Area Of Dust Inlet, sq. in.	B.	C.	D.	E.	F.	G.	H.	Wgt. lbs.
000	6	28								
00	7	38	32	26	37	7	6x7	10	12	70
0	8	50								
1	10	78	42	38	48	12	10x12	14	14	180
2	12	113	46	37	48	12	10x12	17	14	240
3	14	154	54	42	60	16	10x14	17	16	471
4	16	201	60	45	72	16	14x16	22	26	490
5	18	254	66	54	72	16	16x20	25	26	500
6	20	314	72	58½	76½	16	14x24½	27½	26	530
7	22	380	84	65½	96	16	16x25	32	27	682
8	24	452	87	67¾	96	16	18x26	34	27	889
9	26	531	96	78	96	16	18x32	46	27	1,137
10	28	616	102	84	96	16	18x37½	40	27	1,250
11	30	707	111			16				1,500
12	32	804	114	90	120	16	22x41½	46	27	1,800
13	34	908	117	97	120	16	23x44	48	27	2,000
14	36	1,018	129	105½	120	16	24x45½	50	27	2,050
15	38	1,134	132⅝	111	120	16	26x44½	53	27	2,150
16	40	1,257								
17	42	1,385								

By making the radius more than twice, the resistance begins to increase again until at six diameters it is equal to a straight pipe 3 ft. long. This is due to the greater distance the air is under compression on one side of the pipe while making the turn.

FRICTION OF AIR TRAVELING THROUGH PIPES.

Friction of the air traveling through the pipes is another and very essential point for consideration, and it must be determined in order to know the minimum speed at which the fan can be run. Careful experiments have shown that a length of round pipe from 62 to 72 times its diameter will produce friction equivalent to the velocity head, the shorter length applying to small pipes, because of the relatively greater resistance the roughness of the surface presents per unit of volume. In actual practice, it is customary to allow about 40 diameters, to compensate for branch tees, reducers, dents, etc. The refuse carried along by the air also increases the resistance somewhat.

RULE FOR EQUALIZING RECTANGULAR AND ROUND PIPES.

Rectangular pipes can be compared with round pipes by multiplying the area of the square pipe by four and dividing by the perimeter of the square pipe; the result is the corresponding diameter of a round pipe for the same velocity. Or, to put this in the form of an equation

$$D = 4\,W\,H \div 2\,(W + H)$$

In which W is the width of duct; H is the height; D is the diameter of a corresponding round pipe.

The friction for varying diameters of round pipes is inversely proportional to their diameters, at a given velocity.

The friction of rectangular pipes at the same velocity varies inversely as the square root of their respective areas.

The friction of any pipe is directly proportional to its length.

As an example, take a 12-in. diameter pipe conveying air at 3,600 ft. per minute velocity at 72° F., barometer 30 in., humidity 50%. A velocity of 4,000 ft. per minute is equivalent to 1 in. pressure. Hence, for 3,600 ft., the pressure would be

$$\left(\frac{3600}{4000}\right)^2 = 0.81 \text{ in. water gauge.}$$

As 40 diameters offers friction equal to the velocity pressure, then $\frac{40 \times 12}{12} =$ 40 ft. of length corresponds to 0.81 in. friction. As the friction is directly proportional to the length, then for 100 ft. the friction would be $100 \times 0.81 \div 40 = 2.025$ in.

Supposing we have 100 ft. of 12×12 in. pipe. A round pipe offering equivalent friction at 3,600 ft. velocity per minute would be $\frac{4 \times 12 \times 12}{2 \times (12 + 12)} = 12$ in. in diameter.

The round pipe would, however, deliver 2,830 cu. ft. per min., whereas the square pipe delivers 3,600 cu. ft. per min.

If the friction of a 12-in. pipe is 2 in., then the friction of a 14-in. pipe would be $2 \times \frac{12}{14} = 1.715$ in.

If the friction of a rectangular pipe having 1 sq. ft. area is 2 in., then the friction of a similar pipe having 2 sq. ft. area would be $2 \times \frac{1}{2} = 1$-in. friction.

In the application of fans to the removal of smoke, fumes, fine dust, obnoxious gases, etc., great care has to be exercised in so designing the hoods that they will not interfere with the process, that they will not be in the way of the mechanics, and still be capable of catching the floating material before it gets into the room. Most failures in such installations are due to the pipes being too small.

For example, supposing a hood of conical form is 3 ft. in diameter at the mouth with a 7-in. pipe attached at the top. With a velocity of 4,000 ft. per min. in the 7-in. pipe, the velocity is only 151 ft. at the mouth, or less, about 2.5 ft. per second.

A very efficient though somewhat expensive hood of this type is to put one hood inside the other, leaving about ⅜ in. space between all around the bottom, and then run a nozzle from the apex of the inner cone up into the pipe which

is attached to the outer cone. This nozzle should be about half the area of the pipe. With such a hood anything that rises up into it cannot escape around the rim even if it is not drawn off by the central connection.

A common rough rule for determining the diameter of pipe for round conical hoods is to make the bell-mouth 1 ft. larger in diameter than the apparatus it is to cover and increase this diameter 1 ft. for every 2 ft. elevation above 2 ft.; then to make the pipe one-sixth the final diameter of the mouth as thus determined. For instance, a kettle 2.5 ft. in diameter, having the bottom of the hood 2 ft. above it, would have a hood 3.5 ft. in. diameter or 42 in.; the pipe would be one-sixth of this or 7 in. diameter.

Hoods to grinding and buffing lathes have to be designed to suit the character of the work done on them. A hood suited to one class of work on a given type and size of lathe may be wholly unsuited to some other class of work on exactly the same lathe. For instance, the grinding of some things can be better done on the top of the wheel, while others are more easily ground in the middle or below the center of the wheel. Like everything else, this comparatively simple thing, when viewed as a complete installation, presents its complexities and problems for solution, and it requires the same "good old horse sense," "hard knocks," experience and observation that any other engineering problem does.

A discussion of the fan problem as a part of this subject has been purposely avoided, as it would take more space and time of itself than has been devoted to the rest of the subject.

DISCUSSION.

THEO. WEINSHANK: I am sorry the author has omitted one point, that is, the relation of the fan used for the removal of refuse to the heating system. In a large plant for the removal of refuse, this has a great effect on the heating system. In this connection I had an experience several years ago in designing the heating apparatus for a large mill in northern Wisconsin. It was to be a blower system and we naturally asked the number of machines that were to be connected to the refuse fan. On obtaining this list, we took into consideration the amount of air the refuse system would remove from that building, in addition to what was required to heat the building. After the system was designed, the owners decided that they required six more saws, which, of course, increased the duty on the fan for the removal of shavings. The fan they had was not large enough for this increased service, so they installed another one, with almost 100% additional capacity.

When the heating system was started, it was found to be not large enough and the owners could not understand it.

PROF. J. D. HOFFMAN: I think this is a splendid paper and one that is very timely. The engineers of the country have been spending their time very largely in perfecting and improving the apparatus, the prime mover, and have neglected the distributing system. We have been very careful to look for each per cent. of efficiency in the engine but have winked at the losses of far greater magnitude elsewhere. Like the man who buys a high priced engine and throws away his exhaust steam. Here we take the other end of the proposition and I think it is a splendid idea.

I would like to refer to the expression, "On the plan mark the sizes of the various branches; then add these areas together whenever two or more pipes join and find the resulting diameter of the main," and inquire of Mr. Still if that represents his practice in laying out the mains system? Is this worked out from the standpoint of areas and velocity or does friction enter into it?

MR. STILL: Velocity only.

PROF. HOFFMAN: Then the friction has not been taken into consideration?

MR. STILL: The areas have been added together to determine the size of the main, and then as other branches are added in their areas are added to the last to increase it again and the velocity is the thing we have in the exhaust fan system, regardless of volume; and the friction of the entire system determines the total pressure.

Speaking of the connection of refuse disposal systems with the heating, I have

had trouble in the same way when combining heating problems with refuse handling problems. I remember one instance in Kentucky where they had an excessive amount of machinery to take care of in proportion to the size and cubical space of the buildings. But those fans handled just about the same volume of air as the heating plant did; they had a line of pipe running down overhead, with branches pointing out horizontally, as customarily done in buildings of that type. We simply extended these branches down so that they came within about 2 ft. of the floor, to get under the strata which was level with the bottom of the hoods. The workers had complained of being cold up to their waists but by piping the air down into this lower stratum, the difficulty was remedied.

I have not seen a case where the exhaust fan handled more air than was put in by the blower system but I have seen factories that have been lowered 10 or more degrees when heated by direct radiation, by introducing an exhaust system without increasing the radiation.

VICE-PRESIDENT HALE: I remember a case some years ago in one of the plants with which I was connected, where the apparatus was designed for direct radiation and they thought of putting in exhausters at the time the original heating plans were laid out. After the apparatus was started, we got a complaint that they could heat one of the buildings very successfully during the noon hour, but the rest of the time it was almost impossible to get satisfactory results. On investigating the complaint, we discovered that they had put in a number of shaving exhausters and the air was being drawn out so rapidly that it was impossible to heat with the original amount of radiation. We had to increase it, I think, about 100% to get suitable results.

H. W. WHITTEN: It appears by this paper that the same amount of horsepower applied to produce suction is more effective than the same amount of horsepower applied to producing pressure. I would ask if the author has ever observed anything on this subject that would throw any light on the matter of the impact of air or its suction effect while in motion.

MR. STILL: It is impossible to remove the waste from most machines by a pressure system. It can be handled by an exhaust system much easier. There are some cases where it might be possible to attach an air blast as, for instance, on an emery wheel, to blow the emery dust into the hood, but then you have to put in an exhaust system to carry it away. You could not put in a blast system which would carry the refuse to the point of discharge very well.

As to the effect on an exhaust fan or any other kind of a fan, whether it is intended to move air by exhausting or blowing, it does not make any difference, the effect on the fan and the power required is the same, although the mechanical efficiency will not show the same. You cannot get the same maximum mechanical efficiency to show from measurements taken on the exhaust side that you can on the discharge side, but the horsepower is the same. It is one of the peculiar things we have never been able to find a satisfactory reason for. It is undoubtedly due to some effect produced by the efflux of air into the inlet which the measuring instruments do not take into account.

L. C. SOULE: To give an idea of the amount of extra radiation required to warm the air taken out by exhaust systems, I had occasion recently to figure on a plant designed for direct radiation heating, with pipe coils to take care of the transmission through the walls and roof. The exhaust fans were exhausting 85,000 cu. ft. of air per minute and it was necessary to provide 4,000 sq. ft. of blast coil surface to take care of this.

J. H. DAVIS: I remember two cases, one in South Bend and the other in St. Johns, Canada, where exhausters were used. The additional amount of radiation on the floors that had exhausters was 30% greater than it was on the other floors and the amount required was only determined after a number of trials to find out just what was needed.

MR. WHITTEN: I would like to ask Mr. Soule to repeat his statement.

MR. SOULE: I thought it would be interesting to state just exactly what would be required in the way of additional heating surface and boiler horsepower to warm the air exhausted by the fans of the exhaust system. The fans exhausted

85,000 cu. ft. of air per minute and the amount of extra heating surface necessary to warm that air to 65° was 4,000 sq. ft. That, figured at 1½ lbs. of condensation per square foot per hour, would be equivalent to 200 H.P. That was in addition to the losses due to walls and glass.

Temperature Equivalent of Wind Velocities.

In a discussion of a paper on this subject, read before the American Society of Heating and Ventilating Engineers and published in THE HEATING AND VENTILATING MAGAZINE for August, 1912, further light was thrown on the impact effect of wind, the effect on the leeward sides of buildings, and also the effect of varying air pressures, as observed from barometric readings. Mr. Whitten stated in his paper that he had found 1 mile of wind movement per hour to be equivalent to 1° F. change in temperature, but that this relation was not constant, as there appeared to be a greater proportion of loss due to wind movement as the temperature drops. He also found a regular rate of increase in effective pressure as the temperature drops, although the wind velocity may remain constant. Moreover, a barometrical change caused changes in the impact pressure.

DISCUSSION.

J. D. SMALL: I would like to ask what type of buildings these observations were made on, whether office or factory buildings.

J. A. DONNELLY: I think this subject of impact effect of wind might be studied mathematically and shown graphically by figuring the impact of the wind varies with the weight of the air; that is, that a diagram might be drawn showing the increasing impact of the air as it cools in temperature and so becomes more dense, and as the height of the barometer increases. It is something which would certainly be expected that as the air increases in weight its impact would be greater upon an instrument for measuring such force.

MR. WEINSHANK: Referring to the author's statement that from 40° to 15° F., 1 mile of wind movement per hour, is equal to 1° drop in temperature," this refers to the so-called windward, or indirect side. Will this hold also on the non-pressure, or suction, side of the building? The author states that it will, without giving any data. If this effect is true on the windward side of a building I do not think it could be true on the suction, or non-pressure, side.

PROF. J. D. HOFFMAN: The author says that "the difference in weight between air and water vapor being very small, this factor does not appreciably change the result." I would like to ask his opinion in regard to that.

MR. WHITTEN: In regard to the type of buildings, they are a group of educational buildings. They are quite large, and have the average number of glass openings. The buildings are constructed in the form of a U, with the open mouth of the U facing about northeast and having windows on all sides. The sides of the U are subdivided, with courts, so that there are wind pockets and there are practically all the irregular conditions that might be found in various types of buildings.

MR. SMALL: It occurred to me that with a corridor, the corridor would act as a ventilator. In that case, the building being constructed as you say, it might tend to decrease the proportion of loss on the non-suction side. Bit if it were a factory building I can see how the infiltration and outward leakage might possibly be in the same proportion.

MR. WHITTEN: In regard to the suction side of buildings, this outflow was ascertained by a special apparatus applied to the cracks about the windows and about the doors on the various faces of the building, an instrument that would record air movements in or out. There appeared to be a slightly greater outflow in all cases where there was an inflow. These buildings are heated by steam radiation, supplemented by a supply of warm air delivered by fans. It has been my experience in investigating these conditions for some years that almost invariably where there is an independent air supply to the buildings from the walls or wall crevices, the outflow, provided that the buildings stands in an isolated position, will be greater in volume than the inflow.

In regard to the moisture content, the figures quoted were taken from the observations of Mr. Albert F. Zahm, and indicate that the moisture is never over 5% of the mass of the air and rarely over 2½%, meaning, as I understand it, that the weight of moisture in a given bulk of air is never over 5% of the whole. I think that is about right.

Committee to Cooperate With District Heating Engineers.

The American Society of Heating and Ventilating Engineers, has appointed the following committee to confer with a similar committee of the National District Heating Association on educational matters in heating and ventilation: E. F. Capron, Chicago, Ill.; D. M. Quay, Cleveland, O.; W. F. Devendorf, Rochester, N. Y.; M. L. Foote, Columbus, O.; and W. C. Green, Cincinnati, O.

NATIONAL ASSOCIATION OF MASTER PLUMBERS has established its headquarters at 1482 Broadway, New York, Suite 910, between 42nd and 43rd Sts. W. E. Crosby is executive clerk.

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THE ATTENTION of our readers is called to the enlargement of the reading pages of THE HEATING AND VENTILATING MAGAZINE to standard magazine size. This applies also to our advertising pages. The change means a material increase in the amount of reading matter that will be published each month, while the advertisers will benefit through the enlargement of their spaces, permitting, among other things, the use of additional and more detailed illustrations of their products.

Incidentally, it may be said to mark a long contemplated step in further improving the appearance of THE HEATING AND VENTILATING MAGAZINE. Our energies will now be bent on an expansion of the magazine's editorial activities, with a view of supplying our readers to an ever-increasing extent, with the latest advances and practice in the field represented by this journal.

FURTHER announcement is made of a readjustment of our advertising rates, commencing with the issue for January, 1913. Up to that time contracts for periods not exceeding one year will be made on the present basis, but with the opening of the new year, the revised schedule will become effective.

In spite of the increased cost of production and the greatly widened circle of its readers, THE HEATING AND VENTILATING MAGAZINE, up to the present, has maintained the same rates for space in its advertising pages that were in effect at the time of its establishment. With the growing opportunities for usefulness the magazine faces a future brilliant with promise, in which advertisers as well as readers may expect to share in full measure.

ANYONE who will give a moment's thought to the views expressed in this issue regarding the problems still facing the ventilating engineer in the matter of "fresh" air supply, will realize how far we have still to go before we shall arrive at the ultimate practice in heating and ventilating engineering. In Washington, for instance, last month, at the International Congress on Hygiene and Demography, four of the important topics for discussion were, "Organic Matter in Expired Air," "Unknown Factors in the Ill Effects of Bad Ventilation, "The Hygienic Physiology of Work in Compressed Air" and "Effect on Blood Pressure of Children of Various Methods of Ventilation." And this is but one of many quarters where the spirit of research and investigation of this subject is plainly apparent. Thus the next few years will no doubt be marked by rapid strides in the art, all of which will be reported in due course in our columns.

Analysis of Operating Conditions of a Central Hot Water Heating System.

By Ira N. Evans.

An analysis of the description and schedule of operation of the Oak Park (Ill.) heating plant, published in your August 1912, issue, brought out several facts which may be of interest to your readers.

There are 550,000 sq. ft. of radiation and 85,000 sq. ft. of surface in the mains. Using 0.04 for the factor (from Gifford's "Central Station Heating") for the radiation of mains, we have as follows: 3,400 lbs. of steam per hour radiation of mains. The steam for the heating surface under maximum and minimum conditions is as follows, estimating the gallons per minute from size of mains and loss in head:

Average Outside Temp. Deg. F.	Temp. Water Deg. F.	Temp. Steam Deg. F.	Pressure	Steam per Hr. Lbs.	Deg. Drop	Head Ft.	Gallons per Min. estimated	Trans. B. T. U. per Hr. per Deg. Diff.
65	132	151	22 in. vac.	38,016	25	81.4	3700	1.076
20	196	234	7.6 lbs.	122,000	66	112	3200	1.7

The mains have a cubic content of 60,000 gals. of water which has to be raised and lowered each time the average temperature of the system is changed to suit the weather variations. This would be 500,000 ÷ 34,000 = 16 H. P. per degree change and one-half of this would be 8 H. P. for the supply mains. If the drop were reduced from 60° to 30°, or one-half, the variation would be 120 H. P. instead of 240 H. P. This is not strictly a loss, but represents a backlash or the degree of lack of responsiveness of the system as a whole to change in temperature.

Although the head on the pumps is supposed to vary from 75 ft. to 120 ft. head, the estimated gallons pumped seems out of proportion to the power used, according to the schedule furnished. These pumps show their connections in parallel and if they are rated the same head and gallons the piping requirements might demand their connection in series, or at least some of them, to get the best results.

The actual gallons circulated is not given and had to be estimated. Possibly there is no meter, in which case it would be well to determine the actual quantity of water circulated.

The transmission shows a large portion of the heating surface turned off in moderate weather. A great saving would be made if the pumpage on this plant were doubled, especially in weather below 15°. The friction of water in the mains would tend to reduce the drop, and the extra power, as the plant is a live steam proposition, would be no additional charge.

There would be a material reduction in the average water temperature in moderate weather, as well as the required steam temperature in the heaters, affecting the economy of the turbine during periods of excess power load, or the heating surface in buildings might be reduced in amount and regulated at the plant so that it would be all in use at all times—thus decreasing the cost of installation.

This would mean a reduction of some 2 lbs. of steam per kilowatt hour or more power would be obtained for a given amount of exhaust steam before using it for heating. The extra pumpage would increase the efficiency of both radiation and heaters noticeably.

There might be one difficulty that would be aggrevated and that is by-passing and short-circuiting, but less allowance would have to be made for different temperatures of radiation along the line.

WOULD ELIMINATE WATER BOILERS.

There are 3,000 H. P. in the steam boilers with 1,800 H. P. in the water boilers. It seems to the writer it would be far more economical from an investment standpoint to change all the boilers to steam under the same pressure and use a live steam heater with gravity return for the condensation. The water boilers are idle in summer and a large portion of the time in winter, according to the text and the figures of the operating schedule.

There were formerly patents controlling this arrangement but they have expired and it is open to universal use. This would eliminate two kinds of spare boilers and the same equipment could be used for both power and heating, as the boilers would be available for heating when the exhaust from the power load was inadequate.

The higher pressure boiler and live steam heater is much more flexible to operate, as the fires on water boilers have to be banked, drawn or rebuilt, as occasion demands.

A reducing valve connection on the exhaust heater is not as economical on ac-

count of the pumping of the condensation to the boilers.

The present economizer could be utilized for feed purposes for the battery of the hot-water boilers changed to steam.

The writer does not believe the use of hot-water boilers and economizers can be justified from an investment standpoint. No economizer in a properly-designed plant is good for more than 15% of the heat of the fuel actually burned under the boilers and the cost of installation is equal or greater than the equivalent capacity in extra boilers. The flue gases can be reduced to the limit of draft requirements, as the temperature of the circulated water is low. The same money could be better invested in extra water boilers if they were absolutely necessary.

The foregoing statement has no reference to the use of economizers on high-pressure steam boilers, as the higher temperatures materially alter the conditions. Generally it is impossible to make an economizer pay interest and depreciation, where used solely for heating seven months in the year, and where it does pay for feed water purposes there is nothing in robbing the latter for the heating system.

There are periods of light power load when there is advantage in utilizing an economizer on the heating system, but, if adopted, the saving in heating the feed water should be sufficient to cover all charges.

Is it not possible if the drop on the plant were reduced by increasing the pumpage, the effect of the wind velocity would not require such a variety of operating schedules? The supply temperature seems to have been arbitrarily fixed and the drop and return temperature manipulated to give the proper results.

Legal Decisions

Indivisible Contract Unenforcable in Part Where Void in Part

A contract for repairing a county courthouse was held to be unenforceable on account of illegality in the bidding. It included items for plumbing, wiring and heating. The bid for these items was not subject to the vice of the general contract in so far as the bidding was concerned; but instead of following the declared intention and purpose to let two separate contracts, all the subjects of bids were embraced in one contract when finally reduced to writing. While they might be severable from the general contract under ordinary circumstances, with the general contract stricken down, the contract for wiring, heating and plumbing could not be executed or complied with, and was so dependent upon the execution of the general contract that the whole must fall together.—Ness vs. Board of Commissioners of Marshall County, Indiana Supreme Court.

Contractor's Lien for Heating Plant as Against Purchaser of Building

A contractor installed the heating plant and plumbing in a building under a contract with the legal owners. Prior to its completion, negotiations were made with a view to the sale of the building, and the purchaser became satisfied, from a purported receipt from one of the owners and a telephone communication which he claimed to have had with the contractor, that the claim of the latter was fully satisfied. In an action for the foreclosure of mechanics' liens the evidence showed that there was due on the contract $3,041.05. The trial judge did not make formal findings of fact, but it was clear from his remarks that he believed the receipt to be a forgery and that, if the telephone conversation occurred, it was not with the contractor, though the purchaser may have thought he was talking with him. The contractor's lien was, therefore, not affected thereby. A written release was executed by the contractor to the original owners, reciting that as they were about to sell the property he discharged them from all liability for labor performed or materials furnished on the building. This paper was executed without any consideration, and as between the original owners and the contractor it had no validity. Assuming that it was executed to enable them to sell the property by showing that the contractor's lien had been satisfied it appeared that it was never used for this purpose, as the purchaser never heard of it until about the time of the trial, long after the purchase. He was, of course, in no way influenced by it at the time of the purchase. Hence it did not work an estoppel in his favor as against the contractor's right to his lien.—Seattle Lumber Co. vs. Cutler, Washington Supreme Court.

Breach of Warranty—Measure of Damages

In an action for breach of warranty of a ventilating apparatus, the measure of the buyer's damages, where the finding was in his favor, was held to be the difference in value between the apparatus delivered and

as warranted.—L. J. Wing Mfg. Co. vs. Dairyman's Mfg. Co., 136 N. Y. Supp., 66.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Delegates to Conservation Congress.

The following members have been appointed delegates to represent The American Society of Heating and Ventilating Engineers at the Fourth National Conservation Congress, at Indianapolis, Ind., October 1-4, 1912: Samuel R. Lewis, Chicago; N. L. Patterson, Chicago; J. H. Davis, Chicago; Theodore Weinshank, Indianapolis, and John G. Hayes, Indianapolis.

New York Chapter Nominations.

Nominations for officers of the New York Chapter of The American Society of Heating and Ventilating Engineers for the coming year have been made as follows: For president, Frank G. McCann; vice-president, D. D. Kimball; secretary, Joseph Graham; treasurer, Arthur Ritter; board of governors, W. M. Mackay, Conway Kiewitz and W. W. Macon. The election will take place at the October meeting of the chapter when further nominations may be made, if desired.

Massachusetts Chapter.

At a recent outing of the Massachusetts Chapter of The American Society of Heating and Ventilating Engineers, at Wayland, the speakers included Col. Everett C. Benton, Republican candidate for Governor of Massachusetts. Other guests were: Congressmen Samuel W. McCall and John W. Weeks, Councillor Alexander McGregor, District Attorney John J. Higgins, of Middlesex County; John J. Irwin, of the State board of agriculture.

Federal Furnace League Dissolved.

A meeting called in Chicago, September 9, by Dr. William F. Colbert, secretary and engineer of the Federal Furnace League,for the purpose of reorganizing to take steps towards the formation of a new organization. This committee will decide on a tentative plan of organization at a meeting to be held in October, and it is hoped that the new organization may be launched before the close of the year. In closing up the affairs of the Federal League, assessments will be levied upon the members to defray any remaining indebtedness. The assets of the league were placed in the hands of the president and executive committee, as trustees.

Differences of opinion on various phases of the league's work, notably in connection with standard ratings of furnaces, are said to be the principal cause of the failure of the league to attract a wider membership which was essential to its continued success. At the time of its dissolution, the membership comprised 31 manufacturers of warm air furnaces.

The committee at work on the new organization is composed of William Ritchie, Boynton Furnace Co., New York; Lewis E. Moore, Moore Bros. Co., Joliet, Ill.; John H. Howard, estate of P. D. Beckwith, Dowagiac, Mich.; George F. Langenberg, Haynes & Langenberg, St. Louis, Mo.; A. W. Williamson, Peck-Williamson Heating and Ventilating Co., Cincinnati, O., and Horace Campbell, Reading Stove Works, Reading, Pa. A seventh member will be appointed by P. W. Elliott, secretary of the New England Stove Association. Letters read at the meeting showed that at least 50 furnace manufacturers could be counted upon to join the new association. The Western Stove Association has also agreed to co-operate in getting additional members.

Ventilation-Testing Device.

An item that is going the rounds of the daily press states that a simple way to tell whether your room is properly ventilated is to place a wide-necked bottle of water into which you have put half an ounce of lime water, in the room, letting it remain uncovered over night. If in the morning the lime water is milk, the ventilation is bad. If the lime water becomes milk on your covering the bottle mouth with your hand and shaking the vessel, the ventilation is not sufficient. If the lime water remains clear, the air of that room is pure.

"Applied Heating and Ventilation" in Its Second Edition.

A second edition of James M. Harrison's notable work on "Applied Heating and Ventilation" is announced, the publishers stating that the first edition was entirely exhausted within seven months of its publication. As this is a $10.00 book, the unusual demand it aroused constitutes a flattering testimonial to the character of its contents. The new edition will be ready October 10. As in the case of the first edition, the book will be handsomely printed and bound. The reading matter, as well as the charts, are printed on one side of the page only so that they will be in convenient form for use on the drafting board.

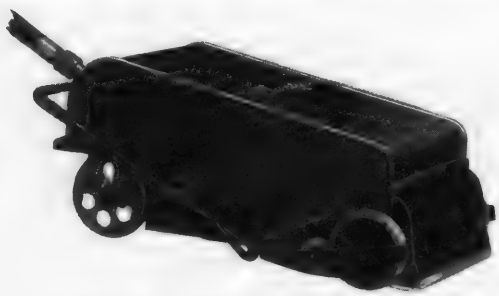
The work contains no fewer than eleven designs of heating systems, covering steam, hot blast and forced hot water, while there are sixteen charts for quick calculations and forty-nine formulas on all phases of heating and ventilation. The book is published by the New York Heating and Ventilation School, 1123 Broadway, New York.

Gifford's "Central Station Heating"

The wide sale of Byron T. Gifford's work on "Central Station Heating" has called renewed attention to the value of this book to the designing and operating central heating station engineer. Since its publication last January, the book has reached the hands of practically every important central heating station manager in the country and has had a marked influence in showing the way to profitable operation of district heating plants. The book has also proved a valuable guide to the designing engineers, not only of city heating systems but also to those called upon to lay out heating systems for small groups of buildings. The handy size of the volume and its limp cover of leather, permitting it to be slipped into the coat pocket, has added materially to make the volume a ready reference manual. The book is published at $4.00 by the Heating and Ventilating Magazine Co., New York.

Duntley Pneumatic Sweeper.

A clever combination of an ordinary carpet sweeper with a vacuum-cleaning machine is shown in the accompanying illustrations of the Duntley pneumatic sweeper, which has recently been placed on the market by the Duntley Pneumatic Tool Co., Chicago, Ill. The suction portion of the sweeper is equipped with a bellows, which



DUNTLEY PNEUMATIC SWEEPER.

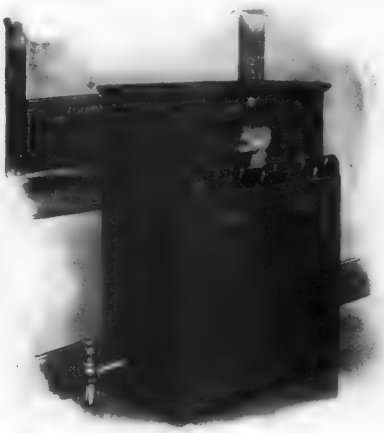
is operated by the turning of the wheels, which also operate the brush. In this way, the brush and suction nozzle supplement each other, permitting a low amount of vacuum to accomplish the same results as would be obtained in a simple vacuum-cleaning machine with a considerably higher

EMPTYING DUNTLEY PNEUMATIC SWEEPER.

vacuum. The manufacturers state that with their No. 1 machine, which sells for $11.75, 96 cu. ft. of free air will be displaced per minute. The machine is intended to be operated by hand. It weighs 9¾ lbs.

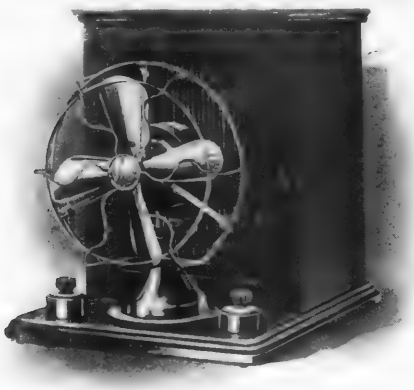
Heating and Ventilating With a Multiple Unit System.

In line with the recent views of experts, as well as of laymen, on proper methods of procuring adequate ventilation of rooms, a multiple unit system has been devised by the Ventilating Systems Co., 126 West 34th St., New York, in contrast to the familiar central blower system. A typical apparatus used with this system is shown in the accompanying illustration. It consists of a cabinet of steel, containing a motor with speed regulator. The motor operates multi-blade wheels, which deliver the guaranteed amount of air per hour. In the lower part of the cabinet is located a special radiator which tempers the incoming air in winter,



DUPLEX MULTIPLE UNIT, OZONE ATTACHMENT OPTIONAL.

having a capacity sufficient to raise the incoming air from zero to 70 degrees F. or higher, if necessary. Beneath the radiator is a water tank, which catches the dirt and dust and also gives the incoming



OZONE GENERATOR, TYPE B.

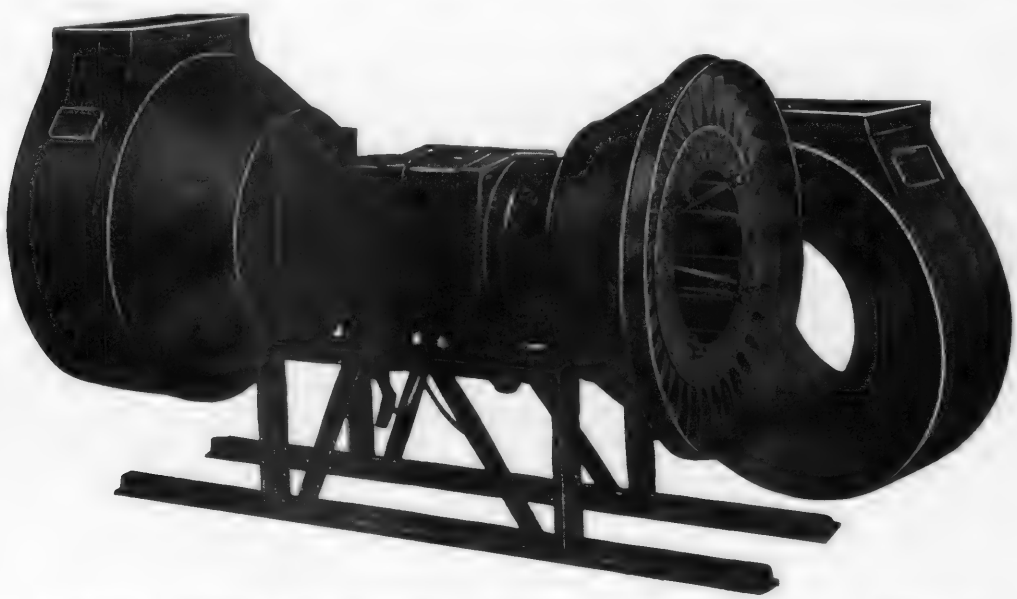
air a sufficient degree of moisture. The deflector at the outlet permits the incoming air to be deflected at any desired angle from the horizontal to the perpendicular. This apparatus is made in various sizes. The cabinets are devised so that they can draw the outside air from any window without in any way interfering with the ordinary operation of the window and without defacing the window trim.

Another feature noted in this system is the possibility of controlling the ventilation in each room to suit the requirements of the moment. Other types of the apparatus are made for use with ordinary radiators and without the water tank.

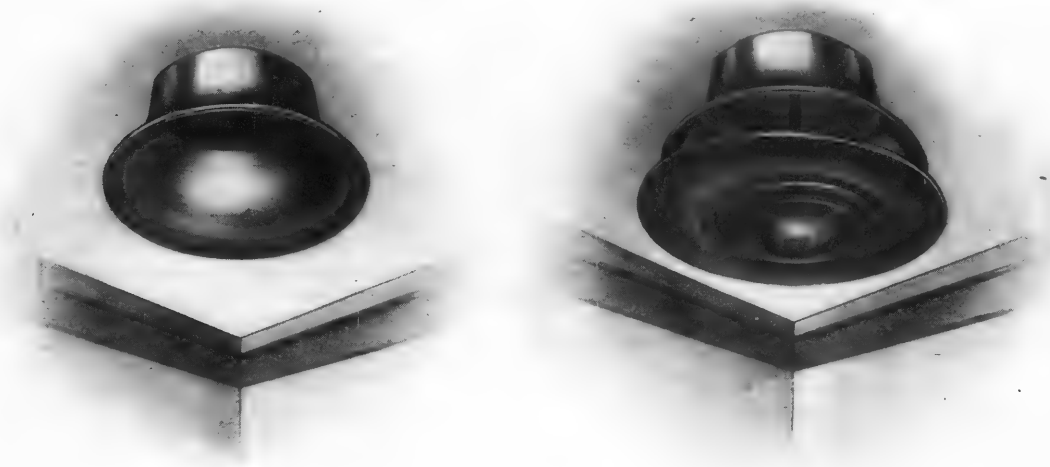
Several models of the Duplex ventilators are equipped with ozone generator attachment, which are made by the company in three sizes. The type shown herewith is suitable for small spaces. Larger sizes are made for use in connection with central systems having built-in ducts. The manufacturers state that recent tests made in crowded schoolrooms equipped with Duplex ventilators having ozone attachments, have shown a decrease of 62 per cent. in the bacterial contents of the air in the remotest parts of the room.

A System That Ventilates With Cold Air.

Acting on the principle that it is unnecessary to heat the fresh air that is being blown into a room for ventilation purposes, a unique system of ventilation is being marketed by the Hackney Ventilating Co., St. Paul, Minn. It is known as the Hackney double centrifugal disc blower system of sanitary electric ventilation. This system is based further on the idea that in order to make any ventilation successful the air must be blown into the building from out of doors and circulated thoroughly without draft, while, at the same time, the foul air must be discharged from the building. Furthermore, the system is designed to



HACKNEY DOUBLE CENTRIFUGAL DISC BLOWERS, WITH ONE END REMOVED, SUSPENDED ON BOTH ENDS OF A SINGLE PHASE REPULSION TYPE, VARIABLE SPEED MOTOR.



Without Diffuser. With Diffuser.

AIR OUTLETS USED WITH HACKNEY VENTILATING SYSTEM.

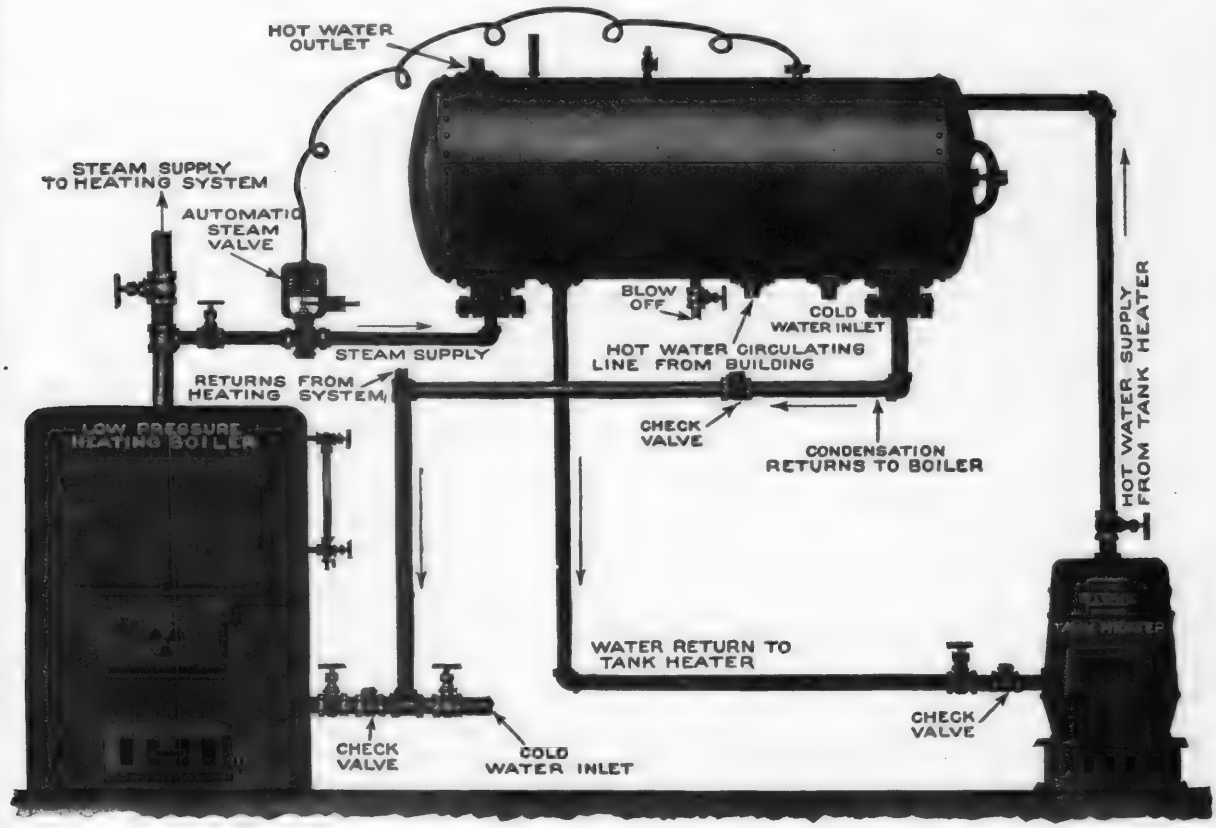
furnish fresh air and to exhaust vitiated air in equal quantities.

The main apparatus consists of two specially designed centrifugal disc blowers. These blowers are mounted in duplicate, either to a double extended shaft of an electric motor, belt drive, chain drive, steam engine or other mechanical power that may be necessary.

Special devices are provided to take care of the low temperature of the incoming air as well as of the outgoing air. These consist of small openings, about 3 in. in diameter each, placed at intervals along the ceiling of the rooms. The fresh air enters through these openings and the foul air is exhausted through similar openings on the opposite side of the room. The blowers, both supply the exhaust, are of the same size and the company make 29 sizes, ranging in capacity from 3,000 to 8,000,000 cu. ft. of air per hour.

This system has been found especially useful in auditoriums, schoolhouses and factories. Special attention is called by the manufacturers to the smoothness with which the system operates and the economy effected on account of the efficiency of the system.

MINNEAPOLIS MUNICIPAL COURT ROOM. EQUIPPED WITH HACKNEY VENTILATING SYSTEM.



PATTERSON HOT WATER TANK CROSS-CONNECTED TO A TANK HEATER.

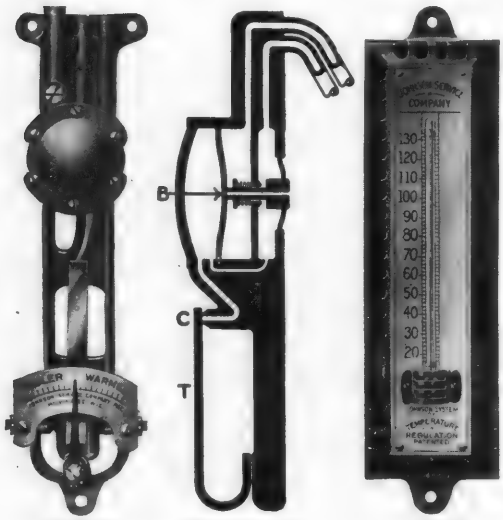
The Patterson Hot-Water Tank.

Where a hot-water tank is connected to a house-heating boiler, one of the necessary requisites is to provide means for heating the tank when the boiler is not in use. In the case of the Patterson hot-water tank, this requirement may be readily taken care of by a stove tank heater. How easily this is done may be seen from the accompanying illustration showing the piping connections for a Patterson hot-water tank heater supplied with steam from a low pressure boiler in which the condensation returns by gravity. The tank, as will be seen, is cross-connected to a tank heater. In connection with this type of tank, the most interesting feature is its heating surface, which consists of a number of parallel seamless drawn brass tubes, both ends of which are expanded into cast-iron tube heads. An improved roller expander is used for this purpose. The shape of the tubes, on the order of an elongated U inverted, provides for the free contraction and expansion of each tube without straining. This design has been found effective in reducing the danger of leakage. Other features of this tank are its expansion chamber, whose combined cross-sectional area is several times that of the steam pipe, and its condensation chamber, which has sufficient area to provide for any sudden increase of condensation, thus preventing the condensation from backing up into the tubes. The tank, which is adapted for live steam, exhaust steam or in connection with any low-pressure or vapor heating system, is made by Frank L. Patterson & Co., 26 Cortlandt St., New York.

Intermediate or Graduated Action Thermostat.

A type of thermostat which is being used extensively, especially in the Chicago city schools, is shown in the accompanying illustrations. It is known as the Johnson intermediate or graduated action thermostat, and is designed to operate in connection with double damper fan blast systems of heating, where it is desired to mix heated and tempered or cold air in proper proportions to maintain a desired room temperature.

This thermostat operates to hold each blade controlling the supply of hot and tempered air partially open in such a relative fixed



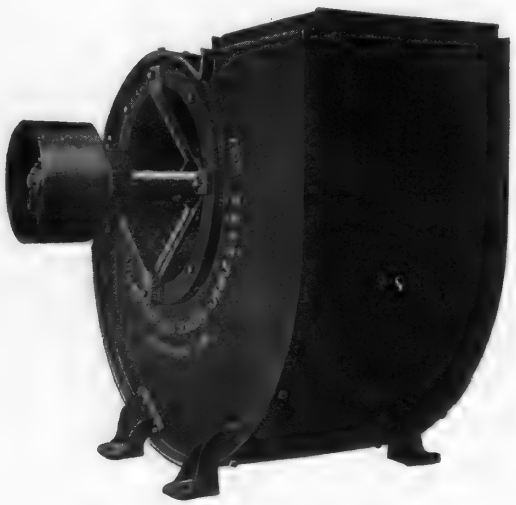
Section Movement Cover

JOHNSON INTERMEDIATE OR GRADUATED ACTION THERMOSTAT.

position as to keep the room at a certain predetermined temperature as long as the temperature of the heated and tempered air and other conditions remain the same, but immediately to change the relative positions of the dampers when any conditions change.

The thermostat is built on the principle of a reducing valve, varying the pressure on the main diaphragm by an auxiliary valve thermostatically controlled, and not depending upon the relative sizes of two permanent leaks.

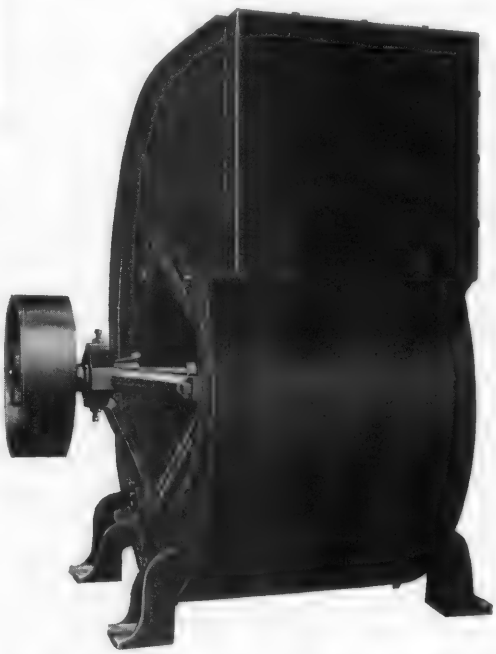
The Johnson Service Co., Milwaukee, Wis., makers of this thermostat, states that in the last five years it has equipped in Chicago alone over 75 school buildings with this type of thermostat.



ILG 40-IN. BLOWER, TOP VERTICAL DISCHARGE FOR BELT DRIVE.

New Types of Belted Blowers.

Two additional types of Ilg blowers, one a 40-in. blower with top vertical discharge and the other 50-in., with top horizontal discharge, have been included in the product of the Ilg Electric Ventilating Co., Chicago, Ill. These blowers have many of the



ILG 50-IN. BLOWER, TOP HORIZONTAL DISCHARGE FOR BELT DRIVE.

features that distinguish the company's line of direct-connected blowers. They are built for universal discharge and drive, making it possible to change any blower in a short time. They can be supported from floor or ceiling by simply bolting the four legs. The use of the Ilg bowl construction gives the machine unusual compactness for one having an overhung wheel. It will be noticed that both the wheel and pulley are overhung, the latter feature making it possible to drive from above, below, or at any angle. The housings are of cast iron while the scroll is of sheet steel. The blast wheel is of the multiblade type. Bearings are of the long type with double ring oilers and large oil reservoirs.

New Books.

MODERN HOSPITALS, dealing with their construction and equipment, is a timely and comprehensive publication, containing over 125 full page and text illustrations of recently constructed hospitals. In some instances the views show their technical equipments. The text takes up such subjects as hospital construction, arrangement, sanitation and mechanical engineering, the articles on heating and ventilation being from the pens of Clarence W. Williams and D. D. Kimball, and presenting the latest practice in this class of work. Size 9¼x12¼ in. Pp. 86. Cloth, $5.00. Published by The American Architect, 50 Union Square, New York, or may be had from the book department, Heating and Ventilating Magazine Co.

PRINCIPLES OF HEATING, by William G. Snow, fourth edition, has been published, being a revised edition of this well-known book, which was first brought out in 1907. The author is careful to base his statements and calculations on a strictly scientific basis throughout the book, and on this account the work will appeal especially to those accustomed to figure heating problems in considerable detail. At the same time, the tables and charts presented by the author for pipe sizes and radiation are in handy form and readily understood. The book is well indexed. Size 6x9¼ in. Pp. 224. Cloth, $2.00. Published by the David Williams Co., New York, or may be had from the book department, Heating and Ventilating Magazine Co.

STEAM AND HOT WATER HEATING, by H. C. Lincoln, is a new presentation of the elementary principles of steam and hot water heating, together with their application to the practical design of complete systems. The author writes easily and lucidly, his purpose being stated frankly to create in the student's mind an interest in the subject which will lead him to continue his studies by the use of more advanced books. The author devites a chapter to special systems of heating, such as vapor and vacuum work, while in another chapter he takes up standard practice in hot blast work. The reviews at the end of each chapter are accompanied by a set of test questions, which make the book especially suitable for class room use. Size 6x9 in. Pp. 160. Cloth, $1.00. Published by the David Williams Co., New York, or may be had from the book department, Heating and Ventilating Magazine Co.

Trade Literature.

PUBLICITY ENGINEERING, describing the methods employed by Walter B. Snow, publicity engineer, 170 Summer St., Boston, Mass., is the title of a cataolgue which in its make-up and attractiveness bears out this firm's reputation for care and thoroughness. Publicity engineering is described as the combination of practical engineering knowledge and advertising experience for the creation of productive publicity regarding technical matters. The catalogue shows in detail how this service is rendered. Size 4x7 in. Pp. 24.

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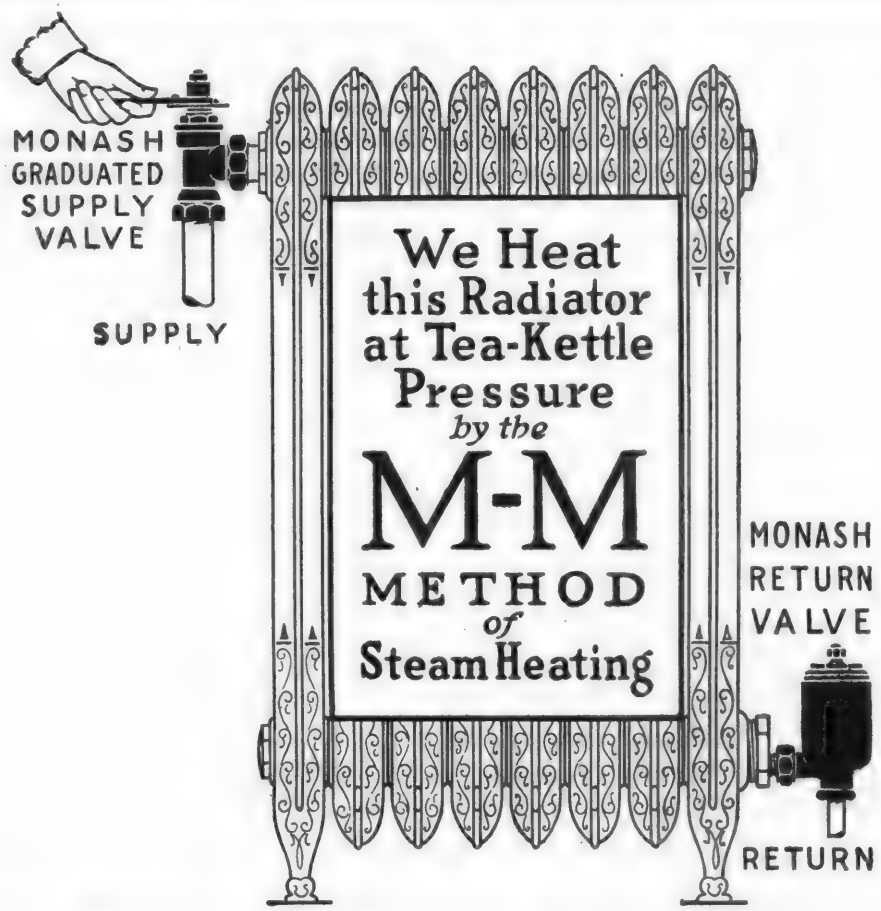
*Every other month.



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JUST as it is wanted and **WHEN** it is wanted

Less expensive and more efficient than a Hot Water Heating System

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TRADE AND MISCELLANEOUS NOTES

Coming Events.

THIRD TUESDAY IN EACH MONTH—Meeting of the New York Chapter of the American Society of Heating and Ventilating Engineers, at the Engineering Societies Building, 29 West 39th St., New York.

DECEMBER 3-6, 1912.—Annual meeting of the American Society of Mechanical Engineers, headquarters at the Engineering Societies Building, New York.

Deaths.

GEORGE E. DOWNE, vice-president and general sales manager of the Novelty Iron Co., Canton, O., died at his home in that city, September 4. He was 54 years old. Mr. Downe was widely known in the heating trade in which he had been a prominent figure since 1887. In that year he organized the National Hot Water Heater Co., which manufactured the Spence hot water boiler. In 1892 he organized the American Boiler Co., in which the interests of the National Hot Water Heater Co. were combined with those of the Pierce, Butler & Pierce Mfg. Co. and of the Richardson & Boynton Co. In this merger Mr. Downe was the vice-president and general manager. When the merger was dissolved a year later, Mr. Downe organized the Ideal Boiler Co., which brought out the Ideal boilers. The American Radiator Company acquired this business in 1896, Mr. Downe joining the staff of the American Radiator Co. as manager of the company's boiler department. He remained with the American Radiator Co. until 1909 and in 1911 associated himself with the Novelty Iron Co., the company that formerly manufactured the boilers for the National Hot Water Heater Co. Mr. Downe leaves a widow and four sons.

WILLIAM H. GALLISON, president of the Wm. H. Gallison Co., Boston, Mass., jobbers of heating and plumbing supplies, and also identified with the Boston Brass Co., died September 5.

STEPHEN T. BRYCE, of the Bryce Heating and Ventilating Co., Toledo, O., died September 9. He was 71 years old.

DAVID M. FORKER, vice-president of the D. T. Williams Valve Co., Cincinnati, O., died at his home in that city, August 29. He was 51 years old and had been ill several weeks.

J. EDWARD MOHLER, of Cuyler & Mohler, Baltimore, Md., jobbers of heating and plumbing supplies, died in that city, August 8. Mr. Mohler was 46 years old.

Miscellaneous Notes.

CLEVELAND, O.—In connection with the city's new central heating plant, a proposal to award the boiler contract for two 500 H. P. boilers to the Babcock & Wilcox Company at their bid of $14,496 is likely to result in an injunction which may prevent the city from carrying out its plans for furnishing heat to the apartment houses and other buildings in the vicinity of Euclid Ave. and East 105th St., this winter. The threat of an injunction is made by William C. Connelly of the D. Connelly Boiler Company, which submitted a bid of $12,572 for this work.

TOLEDO, O.—Acting on complaints against the Toledo Railways & Light Company, made by consumers who object to its changed methods of charging for hot water heat, the city council has unanimously repealed the hot

Armstrong Ratchet Attachment

MADE TO FIT ALL SIZES

ARMSTRONG HAND STOCKS

EXCEPT NO. 1

MANUFACTURED BY

THE ARMSTRONG MFG. CO.

321 Knowlton St., Bridgeport, Conn.

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water heating franchise of the company, to take effect October 1. The company has heretofore charged for the square feet of radiation in the parts of the house where the radiators were installed. According to a recent announcement by the company, it is now proposed to charge according to the amount of radiation in all parts of the house. Thus while the rates per square foot of radiation remain the same at 17 cents per square foot it is claimed that the new arrangement means an increase of from 10% to 40% in the consumers' bills. In commenting on the situation, Homer T. Yaryan, who formerly owned the heating system, expressed the opinion that 17 cents per square foot is a fair price, but that the company should have nothing to say as to the amount of radiation installed. "The company," he stated, "should supply enough water at sufficient temperature to heat houses supplied with adequate radiation and then, if the house is not properly heated, it is up to the owner to provide additional radiation." In accordance with the company's contract with the city, heat was turned on September 15, as usual, to consumers who have signed the new contracts. The case will be submitted to the State Utilities Commission at Columbus by a committee representing the consumers, consisting of City Solicitor Schreiber, C. B. Chambers and George C. Stahl. The heating franchise in question was granted in 1893 and was considered perpetual.

MISSOURI VALLEY, IA.—The W. H. Zimmerman Co., Chicago, is relaying the piping of the municipal steam heating plant of the Iowa and Nebraska Public Service Co. W. W. Reese is in charge of the work in which 50 men are engaged.

SPRINGFIELD, ILL.—Work has started on the new heating plant which the Springfield Light, Heat & Power Co. is building at Springfield. The plant will cost $40,000.

GALENA, ILL.—The Chicago Great Western railroad is preparing to install a system of forced ventilation at the tunnel near Galena Junction, Ill.

CHICAGO.—Only two applicants out of 80 who took examinations for ventilation inspectors passed the test. Those who passed were Thomas A. Cahill and William H. Beckwith.

CINCINNATI, O.—A heating device, invented by D. C. Hale, formerly of Dayton, in which compressed air is used as the heating agent, will be marketed by a company which is being formed by Attorney Charles E. Dornette of Cincinnati. The device is no longer than a cigar box and weighs about 3 lbs. It is proposed to adapt the device, not only to the heating of rooms, but also to street cars, etc., as well as to ripen fruit in transit or storage.

MILWAUKEE, WIS.—Further action on the proposition of building a $500,000 central heating plant for the county institutions in Wauwatosa, proposed in a report on the project submitted by James McAlear, of Chicago, is being held in abeyance pending the investigation of the proposition by the trustees of the institution. T. D. Crocker, a Milwaukee engineer, is expected to present a report on the subject at a future meeting of the trustees. G. E. G. Kuechle, president of the trustees of the county insane asylum, has expressed his disapproval of the plan for a central heating plant.

ATHENS, O.—A special emergency appropriation of $11,200 has been secured by the finance committee of the Ohio University

BETTER THAN LEAD Dixon's Pipe Joint Compound is better and cheaper than red or white lead.
Doesn't "set" joints—goes farther.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

THE McCREERY AIR SCRUBBER

Spray alone will not wash out **soot** and other **oily particles** from the air. These are what produce the **"smoke nuisance."**

Our Air Washers have therefore always been built with wet **cleaning surfaces** to catch the dirt and assist in humidifying and cooling the air.

The **flushing spray heads,** brought out by our Company, are now recognized as necessary to the uninterrupted operation of Air Washers and are specified by the leading Engineers.

The **Experimental Plant** originally installed by us in 1907, has been remodelled from time to time in order to obtain valuable knowledge of air conditioning.

We specialize in **Industrial Work,** as the high efficiency of our cleaning and humidifying device enables us to overcome difficult conditions.

CORRESPONDENCE SOLICITED
McCREERY ENGINEERING COMPANY, DETROIT, MICH.

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trustees to complete the heating and electrical connections of the university's heating and lighting connections. The finance committee is composed of President Ellis, T. R. Biddle and J. P. Wood.

ST. PAUL, MINN.—Estimates for a city heating, lighting and power plant will be asked for as soon as the plans are completed for the new library building. The scheme, as proposed by Mayor Keller, is to heat and light the city hall and court house, jail, the auditorium and the new library from a central plant. The plans are being drawn by City Engineer Oscar Claussen and City Chemist Victor Roehrich. The St. Paul Gas Light Company has already submitted a bid for supplying steam heat for this purpose at a rate of 40 cents per 1,000 lbs.

AUSTIN, TEXAS.—The University of Texas is spending nearly $20,000 on a new heating and ventilating system for the main building of the university.

DES MOINES, IA.—The Smoke Abatement Commission has approved the proposal of the city council to grant permits to lay pipes for block heating system. City Smoke Inspector Harry McNutt stated that if the coal were washed much of the smoke nuisance, due to the burning of sulphur and waste, would be abated.

H. T. GATES, New York, for the past eight years secretary and general sales manager of the McCrum-Howell Co., New York, has resigned to take the presidency of the Hudson Boiler Mfg. Co., with offices at 27 West 42d St., New York. This firm was recently organized, others interested being George L. Greenman, secretary and treasurer; Edward E. Fox, James D. Brady, and B. F. Lane. The company will sell heating and plumbing supplies, as well as boilers.

UNITED HEATING AND POWER ASSOCIATION of Chicago, held its first annual outing at Ravinia Park, August 24. Nearly 100 members were in attendance. At the dinner which concluded the outing President J. J. O'Shea acted as toastmaster. The entertainment committee was made up of George A. Lillig, P. J. Rasmussen and Frank O'Shea.

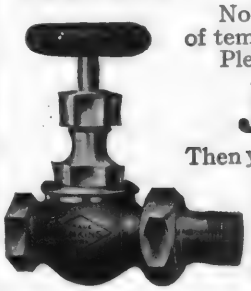
INDIANAPOLIS, IND.—The Merchants' Public Utilities Company has been incorporated as a holding company with a capital stock of $4,000,000 to take over the Merchants' Heat & Light Co., of Indianapolis. It is reported that this move is the forerunner of a second undertaking which may include, under one executive body, another local light company and probably take in a traction line. The same officers and board of directors will be in charge of the new company.

PECK-HAMMOND HEATING CO., Cincinnati, O., has filed suit against the county commissioners, asking that the contract the county made with John Arpp, of Middletown, for the installation of a new heating system in the court house be held null and void on the ground that the bid of the Peck-Hammond Co. of $4,460 was $400.00 lower than the other bid and that the company should, therefore, have been awarded the contract. The county claims that the bid in question was defective in that it did not separately specify labor and materials and that the county commissioners reserved the right in their advertising to reject any or all bids.

CINCINNATI, O.—Application was made for the appointment of a receiver for the Dauch Heating and Ventilating Co., Cincinnati, O., following the disappearance of Alfred Dauch, head of the company. Emil Dauch and Charles A. Spring, who were appointed receivers, state that the assets of the company are apparently equal to the liabilities, but that the receivership became necessary in order to enable the company to complete the contracts it now has under way, including the heating and ventilating of the Fourteenth District School in Cincinnati and the public schools in St. Bernard and Oakley.

WALTER B. SNOW, Boston, Mass., publicity engineer, has added to his staff Chester R. Ross, who will act as manager of the addressing and mailing department.

PERFECT SERVICE DEPENDS UPON THE VALVE



No matter how fine the system, a leaking valve makes regulation of temperature impossible.
Please your clients by specifying the **genuine**

Jenkins Bros. Valves

Then you are assured of receiving valves which are thoroughly reliable, absolutely guaranteed, and ultimately the most economical. Send for our catalogue. It will be mailed free on request.

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NEW YORK BOSTON PHILADELPHIA CHICAGO

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE is the new title of the Bureau of Manufactures and the Bureau of Statistics, which have been consolidated by the Department of Commerce and Labor. A. H. Baldwin is chief of the bureau.

Manufacturers' Notes.

BISHOP-BABCOCK-BECKER Co., Cleveland, O., manufacturers of vacuum pumps for use in connection with steam heating systems, has removed its main offices to 1303 East 49th St., Cleveland.

WILLIAMSPORT RADIATOR Co., Williamsport, Pa., was featured in a recent issue of the Williamsport News, published as an industrial progress edition, showing the growth of the company since its formation in 1905. The company has a present output three times as great as that produced in previous years.

UTICA HEATER Co., Utica, N. Y., announces the election of Frank T. Bassett, Jr., as secretary of this company. Mr. Bassett was formerly eastern sales manager for the International Heater Co., Utica.

ILLINOIS ENGINEERING Co., Chicago, Ill., has added to its staff James C. Matchett, formerly supervising salesman for the vacuum cleaner department of the McCrum-Howell Co.

PRATT & CADY Co., Hartford, Conn., manufacturer of valves, was placed in the hands of a receiver, September 9, by Judge Marcus C. Holcomb, on petition of Amos Whitney and other stockholders. George C. Kimball, of Hartford, was appointed temporary receiver, the amount of his bond being $100,000. The company employs 500 men. Edward L. King, secretary of the company, was later appointed permanent receiver.

LUNKENHEIMER Co., Cincinnati, O., manufacturers of heating and plumbing specialties, will build an additional foundry at its plant at West Fairmount, to contain 75,000 sq. ft. of floor space.

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THERMOMETERS

Are designed for All Ranges and All Purposes. They have been adopted by the largest and best engineering and manufacturing companies in the world. Send for Bulletins and let us tell you WHY

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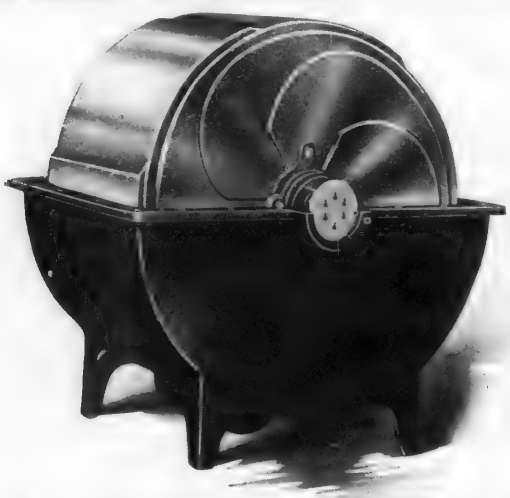

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"IT REVOLVES"

The Simplest, Most Accurate and Most Reliable Condensation Meter on the market.

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CENTRAL STATION STEAM CO.
Detroit, Michigan

J-M ASBESTOCEL
PIPE COVERING

is the most efficient covering for medium and low pressure steam and hot water heating systems, because it confines the largest amount of "dead air." It is built on the arch principle, The air cells are really sealed rings of dead air encircling the pipe, whereas, in ordinary longitudinal air-cell coverings they are cylinders or tubes running from end to end, allowing free circulation of air and resulting in radiation of heat.

Due to its arch construction, J-M Asbestocel is stronger than other low pressure coverings—will not break or crush down under weight and successfully withstands vibration and hard usage. Can be removed and replaced indefinitely.

Being made of asbestos, it is absolutely fire-proof. Prevents sweating and rusting of pipes.

Write our nearest Branch for Booklet.

H. W. JOHNS-MANVILLE CO.

Albany	Detroit	New York
Baltimore	Indianapolis	Omaha
Boston	Kansas City	Philadelphia
Buffalo	Los Angeles	Pittsburgh
Chicago	Louisville	San Francisco
Cincinnati	Milwaukee	Seattle
Cleveland	Minneapolis	St. Louis
Dallas	New Orleans	Syracuse

[1624]

PRESSED RADIATOR COMPANY OF AMERICA, Pittsburgh, Pa., was sold at public auction at the Allegheny Court House, Pittsburgh, September 5, to F. C. Perkins, for $200,000. Mr. Perkins represented the bond holders, and acted for the Fidelity Title & Trust Co., which held a mortgage on the property for $500,000 on a bond issue for that amount. The company had failed to pay the interest on this mortgage and this precipitated the sale. The company was incorporated at $1,250,000 and had $374,300 outstanding in capital stock. It is understood that the sale is part of a plan for the reorganization of the company and that it will continue in full operation as a result of the change. The officers of the company are: President, J. K. Frye; vice-president, F. P. Perkins; secretary and treasurer, A. M. Pearson. Charles Sonneborn is superintendent of works. The sale, which comprised the property and business as a going concern, included 6,097 completed radiators, 124,373 complete sections of radiators, 26,275 sections, amounting to 65,940 sq. ft.; 20,871 radiator brackets, 31,519 radiator legs and 55,600 radiator plugs.

AMERICAN RADIATOR COMPANY'S New York branch held its annual outing at the Jarvis Beach Hill Hotel, Rye, N. Y., Saturday, September 7. Sixty-six of the city salesmen were on hand with W. M. Cosgrove, manager of the New York branch. Others present were Vice-President William H. Hill, vice-president and general manager of manufacturing, A. A. Landon, general superintendent, and J. D. Erskine, district sales manager. After the pleasures of the day were over, including a ball game and a dip in the Sound, the party sat down to a clam bake, at which Vice-President Hill gave some interesting reminiscences regarding the early days of the company when its New York office boasted of but one salesman. He contrasted the early days of the company with the present situation when 66 salesmen from the metropolitan district could be assembled. The committee on arrangements was composed of J. Barnum, Norman F. Whitelaw and E. Reinhard.

MASSILLON, O.—The Board of Trade is conducting negotiations with the Tyler Underground Heating Company, Pittsburgh, for the erection of a factory for the company at Massillon.

PIERCE, BUTLER & PIERCE MFG. CO., Syracuse, N. Y., has appointed Mark Dean to the staff of its New York branch. Mr. Dean will have charge of the sales in the heating department.

INTERNATIONAL HEATER CO., Utica, N. Y., announces that owing to the resignation of F. H. Moore, the general management of the business will be taken by Frank B. Wheeler, the president of the company. The office of

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Used in the

MORGAN-CLARK VACUUM HEATING and FLUSHING SYSTEM

Note the Automatic Self-Cleaning Movable By-Pass

Reduces fuel cost to the minimum. A Flushing System that operates from the engine room, thoroughly cleaning the valves when necessary.

Our 1911 Booklet A takes up Details of Construction and Operation. May we send it to you?

MORGAN-CLARK SYSTEM COMPANY 380 Exchange St. Rochester, N. Y.

treasurer will not be filled for the present. I. L. Jones has been made assistant treasurer, John K. Simkins appointed eastern sales manager. Mr. Simkins, who was connected with the New York office of the company, will make his permaennt headquarters at Utica.

NORTHERN BRASS MFG. CO., Waukegan, Ill., has increased its capital stock from $16,500 to $55,000.

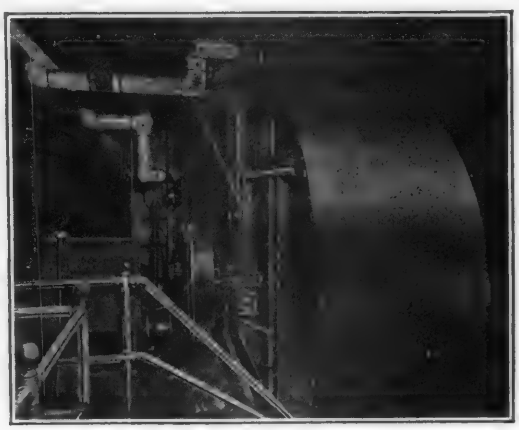
MCCRUM-HOWELL CO., New York, will be reorganized, if the present plans of a committee of creditors are carried into effect. F. H. Moore, until recently treasurer of the International Heater Co., Utica, N. Y., has been engaged to manage the details of reorganization and will then assume the presidency of the company. Evidence that the creditors are not entirely agreed upon the proposition of a reorganization of the firm is shown by the filing of a petition of one committee of creditors in the United States District Court of Philadelphia, declaring that the company is hopelessly insolvent and setting up the claim that the proposed reorganization would be detrimental to the interests of themselves and the stockholders. The court is asked to give authority for selling the plants and winding up the business of the company. The committee at work upon a reorganization is composed of Albert H. Wiggin, president of the Chase National Bank of New York; John C. McKeon, Charles H. Sabin, Herman Waldeck and E. W. Jones. According to the plan proposed by this committee, the present stockholders, in order to participate in the reorganization, will have to pay what amounts to an assessment of $16.00 a share on the present preferred stock and $8.00 a share on the common. The company's present capital of $7,000,000 will be reduced to $1,575,000 preferred and $3,150,000 common. The assets of the comany are appraised at $300,000 as a going concern. The creditors, like the stockholders, suffer heavily in the proposed plan, for the indebtedness of the company stands roundly as $2,000,000 owing to bank creditors and $500,000 to other creditors. To deal with this indebtedness, the creditors may either take 25% in cash for the amount of their claims or 25% in new preferred and 75% in new common stock for the par value of their notes and bills. If the proposed plan goes into effect the new stock issue will be underwritten by a New York banking firm.

RICHARDS-WILSON PIPE COVERING CO., Grand Rapids, Mich., reports that orders have been received for the Ric-Wil underground covering for Shaw's Botanical Garden, St. Louis; Oberlin Gas & Electric Co., Oberlin, O.; the naval station at Guantanamo, Cuba; also Forts

"Sirocco"
TRADE MARK.

"The Original Fan of the Many Blade Plan"

The significance of the term "high efficiency" in the fan world belongs to "Sirocco." Hence, "Sirocco" fans have enormous air-handling capacity for their size, and can be placed in confined spaces which would absolutely preclude the use of any other type.



"Sirocco" Fan Heater and Tempering Coils installed in a small room in the basement of the Masonic Temple, Flint, Michigan

Descriptive Bulletin No. 340 H. V. gives data on "Sirocco." Where shall we send it?
Let us co-operate with you in the selection of proper size of "Sirocco" Equipment for your clients.

AMERICAN BLOWER COMPANY
DETROIT, MICH.
U. S. A.

Canadian Sirocco Company, Limited, Windsor, Ont., Manufacturers for Canada

Riley and Leavenworth, Princeton University and the Emerson-Brantingham Co., Rockford, Ill.

BALTIMORE, MD.—As the result of negotiations with the National Board of Fire Underwriters for the use of surplus power from the high-pressure pipe line pumping station on South St. for supplying light and heat to the court house, city hall and annexes, the contract for the heating system has been awarded to the W. G. Cornell Co., New York, at its bid of $51,230.

BUHL, MINN.—The Cherney Contracting Co., of Virginia, Minn., has begun work on the extension of the mains for the municipal heating plant made necessary by the increased demands for service.

PORTLAND, ORE.—Residents of Central East Portland have won their fight against the operation of the heating plant in the basement of the Hawthorne school. The school board has issued an order providing for the construction of a separate heating plant outside the building to cost $10,000.

New Firms and Business Changes.

SAMUEL J. HOERNER & Co., Dayton, O., is a new firm composed of Samuel J. Hoerner and Charles D. Bidleman, to take over the heating and plumbing business of Samuel J. Hoerner at 320 West Third St., Dayton.

SHEFFIELD Co., Hobert, N. Y., has been organized by M. L. Chappell and B. I. Sheffield to deal in engines, boilers and heating and plumbing supplies.

R. C. BRENNER & Co., Kalamazoo, Mich., has been formed to carry on a heating and plumbing contracting business. Manufacturers' and jobbers' catalogues are requested.

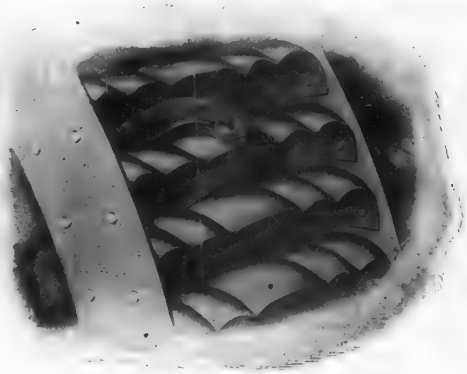
CROOK, KRIES & Co., Baltimore, Md., heating engineers and contractors, have removed their offices to 218 West Saratoga St., where the company now occupies a three-story building 20x150 ft.

New Incorporations

P. J. SULLIVAN Co., Boston, Mass., capital, $10,000, to conduct a heating and plumbing contracting business. Incorporators: Patrick J. Sullivan, Alice G. Sullivan and Nellie A. Pigott.

JOHN E. HOLLAND PLUMBING Co., Akron, O., capital, $10,000. Incorporators: John E. Holland, H. F. Schoenduve and Albert G. Freudman.

G. M. PATTERSON Co., Greensboro, N. C., capital $100,000, to conduct a heating and plumbing business. Incorporators: G. M. Pat-



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Multivane Fan

In the construction of the Sturtevant Multivane Fan every detail, from the rigid riveting of the blades and the strong construction of the spider to the accurate balancing of the fan wheel, has been made the subject of careful study and experiment. The experience of years of fan building has been used to develop a fan rigid and durable, as well as of high efficiency.

Durability is one of the principal features of the Sturtevant Multivane Fan.

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASS.

AND ALL PRINCIPAL CITIES OF THE WORLD 882

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terson, J. J. W. Patterson and W. L. Clement.

PIPE MACHINERY Co., 4907 Mead Ave., Cleveland, O., capital $10,000, to deal in pipe cutting and threading machines. President, William G. Benninghoff, the inventor of the machine; vice-president and secretary, W. C. Grosser.

MISSOURI GAS HEATER & APPLIANCE Co., St. Louis, Mo., capital $25,000, to manufacture heat economizers for use in connection with warm air furnaces. Incorporators: James J. Rohan, H. M. Urbauer and R. A. Crabb.

EDWARD P. BEHRE HEATING & PLUMBING Co., Floral Park, N. Y. Incorporators: William Berg and John Leahy, both of New York.

PHILLIPS HEATER MFG. Co., Boston, Mass., capital $25,000, to manufacture heating specialties. Incorporators: William W. Phillips, Annie R. Phillips and Samuel N. Cohen.

JOHN D. COX Co., Springfield, Mass., capital $10,000, to conduct a heating and plumbing business. Incorporators: John D. Cox, Walter B. Russell and Burdette M. Bancroft.

ARENSMEYER, WARNOCK, ZAHRNDT, INC., 114 Monroe Ave., Rochester, N. Y., capital, $10,000, to take over the heating and plumbing business conducted by Chas. Fisher & Co., their former employers.

MEISTER BROS.-BRACHT Co., Fort Smith, Ark., capital $50,000, to deal in heating and plumbing and electrical supplies.

KITCHEL PLUMBING & ELECTRIC Co., Houston, Texas, capital $10,000, to conduct a heating, plumbing and electrical contracting business. Incorporators: Joseph B. Bowles, Charles M. Kitchel and Jesse Andrews.

VALLEY HEATING & PLUMBING Co., Eugene, Ore., capital $5,000. Incorporators: H. Sweeney, E. Sweeney and George Israelson.

NATIONAL HEATING & LIGHTING Co., Oklahoma City, Okla., capital $25,000. Incorporators: C. W. Stone, A. Schuck and B. H. Grady.

ALLEGHENY COUNTY STEAM HEAT Co., Pittsburgh, Pa., capital $5,000. Incorporators: S. L. Tone, R. S. Orr, A. W. Stevenson, J. W. Murray and W. B. Carson.

CENTRAL HEATING Co., Erie, Pa., capital $50,000. Incorporators: C. H. Strong, S. C. Walker and Thomas G. O'Dea.

CENTRAL CAMBRIA LIGHT, HEAT & POWER Co., Ebensburg, Pa., capital $5,000.

Business Chances.

WASHINGTON, D. C.—Proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

We manufacture the only apparatus made for Paul Air line systems.

If you get the air out of your heating plant, you get rid of nearly all trouble. There is no hammering, no cold loops, the steam flows quietly and noiselessly to every part of the radiator instantaneously.

THIS CAN BE DONE

By simply using the Duplex pump in connection with the air lines. This of course, is the well known Paul System, which has had the confidence of architects and engineers for twenty years. The Paul System needs no brief. There is no royalty charge for the use of the Paul System. A saving of from 10% to 30% on coal consumption can easily be realized.

This type of vacuum pump is known as the "Duplex," and is equipped with electric motor, noiseless in operation. It has an automatic regulator which operates only when there is air to be removed from the radiators.

Send for our new complete catalogue of Ejector Turbine Pumps—used on all Vacuum Systems, either air line or return line.

FISCHER-SWEENY BRONZE CO.

1302-1304-1306 Clinton St. HOBOKEN, N. J.

THE JOHNSON SYSTEM

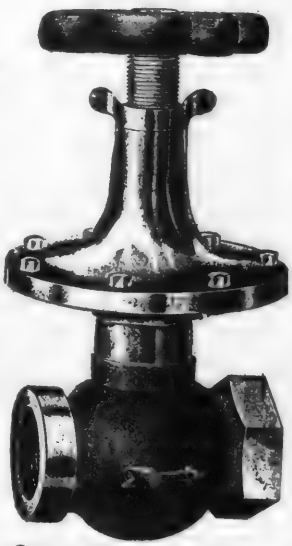
of Temperature Regulation is the Greatest Improvement Ever Made in Heating Systems

Over 100,000 Now in Successful Operation

Air Regulating Valve

We manufacture thermostats to fit every possible condition and they will do the work which we claim for them.

Our system can be arranged to turn off the heat from any room or series of rooms, if desired, through the positive shut-off at the thermostat. The Johnson System is *simple* in construction and *operation* and *positive* in action.



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Until October 30, 1912, for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, etc., of the United States Post Office and Court House at Vicksburg, Miss. Three stories and basement; approximately 8,400 sq. ft. ground area.

Until November 4, 1912, for the construction complete, including plumbing, gas piping, heating apparatus, etc., of the United States Post Office and Court House at McCook, Neb. Three stories and basement; approximately 5,820 sq. ft. ground area.

Until October 21, 1912, for the construction, including plumbing, gas piping, heating apparatus, etc., of the United States Post Office at Moorhead, Minn. Two-story and basement, approximately 4,100 sq. ft. ground area.

Business Troubless.

D. Clarke Son & O'Donnell, 278 Water St., New York, steam and hot water heating contracting, have filed a petition in bankruptcy, with liabilities at $11,709 and assets of $6,071, consisting of stock, $1,000; machinery, $550, and accounts, $4,521. The largest creditor is the H. B. Smith Co., $4,056. The business was started in 1888 by John D. Clarke, who died in 1901. It has since been conducted by Frank M. Clarke and Thomas J. O'Donnell.

Contracts Awarded.

C. A. Law, Chicago, Ill., steam heating, ventilating and plumbing addition to the Hyde Park Hotel, at Lake Ave. and 51st Boulevard.

Hamilton Johnson, Hattiesburg, Miss., is rapidly completing his contract for the erection of a heating plant, sewerage, septic tanks, water mains and stand pipes for the State Normal College at Hattiesburg. A central steam heating plant is being installed, to be operated in connection with the power house.

Kinnison Bros., Dallas, Texas, heating and ventilating the O. M. Roberts, the Thomas J. Rusk, the Ben Milam and John Henry Brown schools for $10,380. Other bids were: Lewis & Kitchen, Kansas City, Mo., $12,150; H. G. Niblo & Co., Dallas, $10,663. The Johnson temperature control system will be used.

Eagan Bros., Toledo, O., heating and plumbing J. W. Scott High School, Toledo, for $81,000.

Stone & Underhill, Boston, Mass., heating and ventilating addition to Center School at Uxbridge for $5,624; also heating, ventilating and plumbing high school addition for $4,566.

Edward P. Burrows, Quincy, Mass., heating and ventilating new Ward 2 School at Quincy for $4,746.

Thomas & Smith, Chicago, Ill., have received a $9,000 order for Acme air washers to be used in connection with the improvement of the heating, ventilating and power plant at the Capitol at Boston, Mass. The piping contract, amounting to $2,490, went to Lumsden & Van Stone Co., Boston.

J. A. Hasley, Anaconda, Mont., heating and plumbing Centre School at Anaconda for $4,925.

John G. Sutton Co., San Francisco, Cal., heating and ventilating Lux School of Industrial Training at San Francisco, for $6,500.

Lettich Bros., San Francisco, Cal., heating, plumbing and gas fitting 7-story building at Ellis and Larkin Sts., San Francisco, for $12,159.

Bangor, Me.—Bids were received as follows for the central heating plant for the high school at Bangor: Wiley & Calhoun, Portland, Me., $13,000; the Isaac Coffin Co., Boston, $14,314, and Huey Bros., Boston, $15,517.

Huey Bros., Boston, Mass., heating and ventilating high school building at Medford, Mass., for $23,847.

Robbins, Gamwell & Co., Pittsfield, Mass., heating and ventilating new William L. Adam School at Pittsfield for $10,300. Other bids included one from Daniel Farrell & Co. for $10,666. The plumbing contract went to L. J. Sullivan & Co., at their bid of $5,495.

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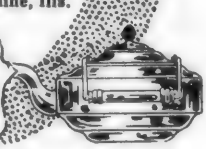

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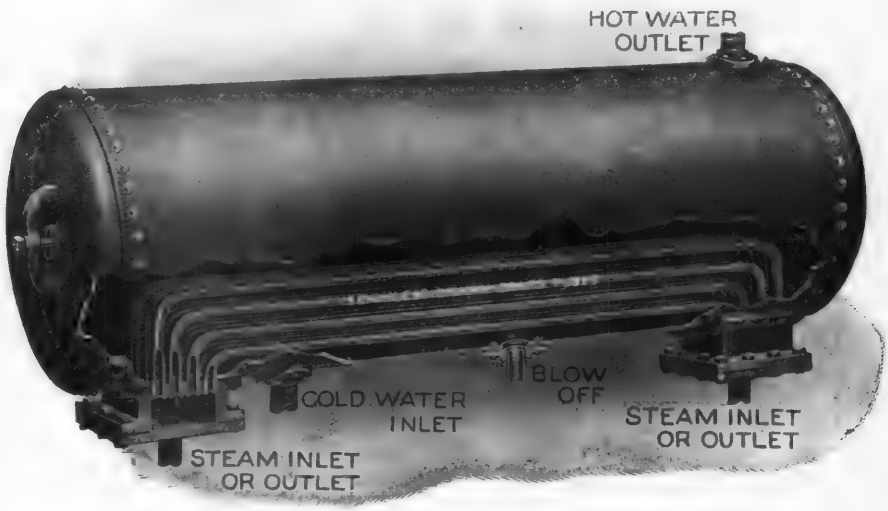

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COLUMBUS MACHINE WORKS, Columbus, O., steam heating and plumbing new school at Whiteland for $10,500.

J. J. O'CONNOR, Cincinnati, O., vapor heating St. Patrick's Church, on Rock St.

C. C. HARTWELL Co., New Orleans, La., steam heating new county jail and jail building at Pensacola, Fla., for $3,398. Other bids were: Carr & Scott, New Orleans, $3,487; Chas. A. Born, Pensacola, $3,500.

MCCARTHY & CRANDALL, Colorado Springs, Colo., steam heating Modern Woodmen's Sanatorium at Colorado Springs. A power plant will be installed which will contain four 110-H.P. boilers. Steam will be carried through underground pipes to the various buildings of the institution. The contract amounts to $50,000.

D. A. DINNIE, Minot, N. D., heating plant for the State Normal School at Minot and erection of main building, at his bid of $81,571.

THOMAS COX & SONS, Little Rock, Ark., heating Deaf Mute Institute at Little Rock, for $6,000.

JOHN R. KEHM Co., Chicago, Ill., installing power plant and heating system in the J. P. Smith shoe factory, at Pratt and Sangamon Sts., for $20,000; also vacuum steam heating apartment building at North Ave. and State St. for Marshall & Fox for $20,000; also boilers and heating systems for seven city school buildings in Chicago for $60,000.

L. O. PAPIN, Dubuque, Ia., heating and ventilating Marshall School at Dubuque.

JOHN ARPP, Middletown, O., heating and plumbing court house at Hamilton, O., for $7,866 (for the heating) and $3,096 (for the plumbing).

W. G. CORNELL & Co., New York, heating court house and City Hall at Baltimore, Md., for $51,236.

AMERICAN HEATING & VENTILATING Co., Philadelphia, Pa., heating and ventilating Arch Street school at Mechanicsburg, Pa., for $2,570.

MCLAURIN & NORTHRUP, Mankato, Minn., steam heating Lutheran Ladies' Seminary at Mankato for $14,000.

J. OTTO HEINZ, Shelbyville, Ill., hot water heating court house at Shelbyville for $3,696.

J. E. O'MARA, San Francisco, Cal., heating and ventilating ten-story and basement building for the Standard Oil Co. at San Francisco, for $17,920.

LEWIS & KITCHEN, Kansas City, Mo., heating and ventilating Harris County jail in Harris County, Texas, for $16,050; the plumbing contract went to Rovischang Bros., at their bid of $10,417.

COLUMBUS HEATING & VENTILATING Co., Columbus, O., heating and ventilating new school building at Huntsville, O.

SAMUEL A. ESSWEIN HEATING & PLUMBING Co., Columbus, O., heating and ventilating new school at Canal Winchester, O.

W. H. HOPSON Co., New London, Conn., heating new City Hall building at New London for $3,030; other bids were: Harry Kennedy, $3,315; Newman Bros., $3,431; Jordan & Cleary, $3,483; Roche & McGuire, $3,806. The plumbing went to Harry Kennedy at his bid of $3,367.

THOMAS BREEN Co., Utica, N. Y., heating and ventilating high school building at Utica for $2,370.

THOMPSON BROS., Philadelphia, installing central heating plant at St. Vincent's Home, 70th St. and Woodland Ave., for $10,000.

MULCH BROS., Altoona, Pa., steam heating Y. M. C. A. building, including swimming pool, at Altoona.

W. P. SWEENEY, Claremont, N. H., remodeling heating system in high school building at Claremont.

HOLYOKE VALVE & HYDRANT Co., Holyoke Mass., heating and plumbing new Elks' Home at Holyoke.

JENNISON PLUMBING Co., Fitchburg, Mass., heating and plumbing new Normal School dormitory at Fitchburg for $7,085.

M. J. GIBBONS, Dayton, O., heating and plumbing new Y. W. C. A. building at Dayton for $20,000.

VICTOR PLUMBING Co., Springfield, O., heating new office building for the Indianapolis Frog & Switch Co. for $2,000; also heating and plumbing addition to the city hospital at Springfield for $3,000.

LEWIS & KITCHEN, Chicago, heating Congregational Church at Grand Ledge, Mich.

AMERICAN WARMING & VENTILATING Co., Toledo, O., heating and ventilating high school at Marion, O., for $7,040. In the last issue this contract was credited by error to M. J. Raimler & Son, Toledo.

CROOK, KRIES & Co., Baltimore, Md., piping for the central heating plant installed at the Tome School for Boys at Fort Deposit, Md. A system of tunnels 5 ft. in height to carry the steam piping to the ten buildings on the campus is being constructed by the Millard McDowell, Fort Deposit. The entire system will cost $30,000. George Adams, Baltimore, Md., is consulting engineer.

RAUTMAN PLUMBING & HEATING Co., Seattle, Wash., heating and plumbing the Smith Building in Seattle. The contract amounts to $150,000. Thirty-five freight cars are required to haul the necessary material to Seattle.

BOND & ABRAHAM Co., Milwaukee, Wis., resetting boilers at the Northern Hospital for the Insane at Oshkosh. The work will cost $2,000.

BAXTER MFG. Co., Springfield, O., heating and plumbing new Central M. E. Church at Springfield for $5,000.

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